

DESIGN, CONSTRUCTION,
OPERATION OF METAL-
WORKING AND ALLIED
EQUIPMENT

MACHINERY

AUGUST, 1940

PRINCIPAL CONTENTS OF THIS NUMBER

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The leading article in September MACHINERY will describe the general manufacturing procedure in the making of over 100 tons of die-castings a day in a plant that probably melts and casts more zinc alloy per day than any other plant in the world. Other articles will deal with aircraft engine manufacture, with the application of cemented-carbide tools to small-lot production, and with gear design.

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THE No. 3A DUOMATIC

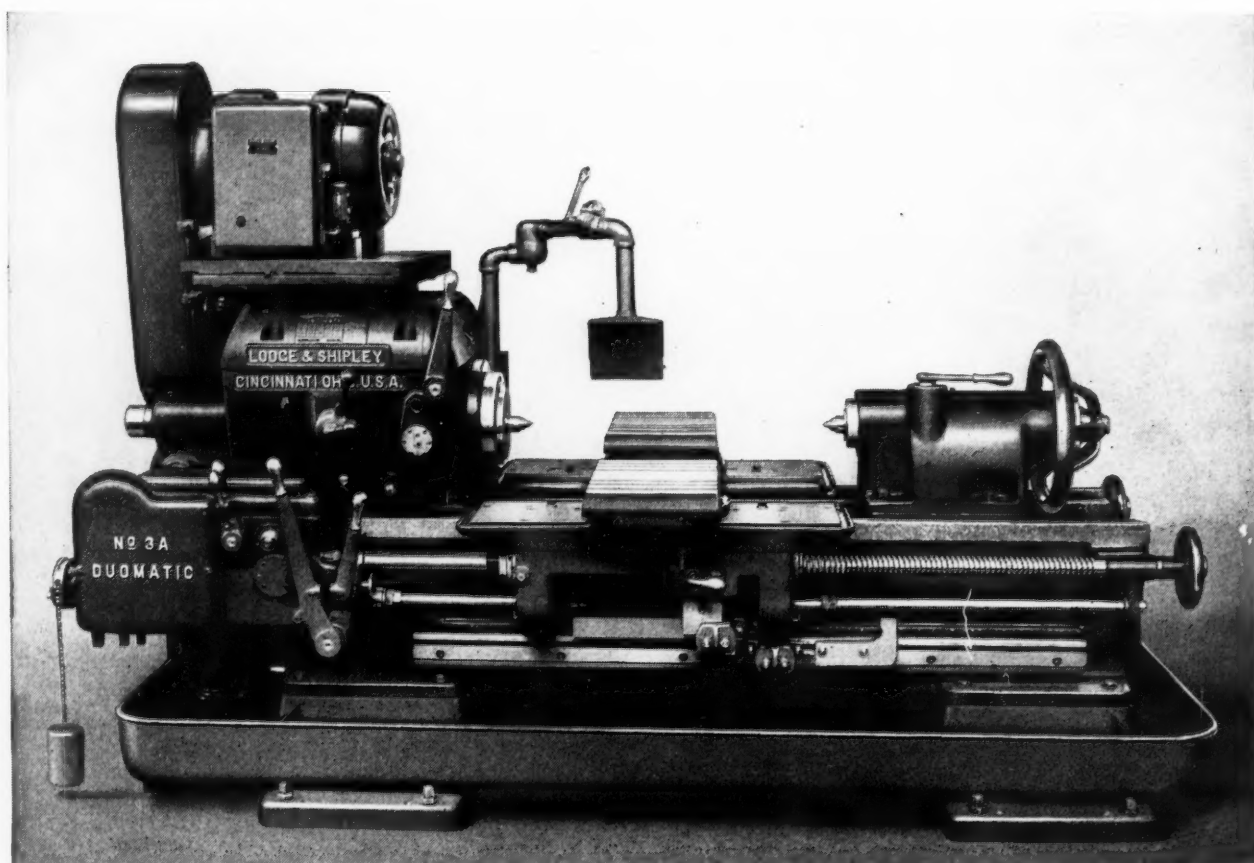
Modern



Insistent demands for time savings and the ever growing call for higher and higher speed production have led to the development of the Lodge & Shipley No. 3A Duomatic Lathe.

That this modern, efficient, general purpose, automatic lathe meets these requirements is proved by the fact that it is adding "More Minutes per Hour" in many leading shops which have modernized production through the application of Duomatics.

These wide range machines not only have the capacity for accurate, economical high production, but offer



The LODGE & SHIPLEY

MACHINERY

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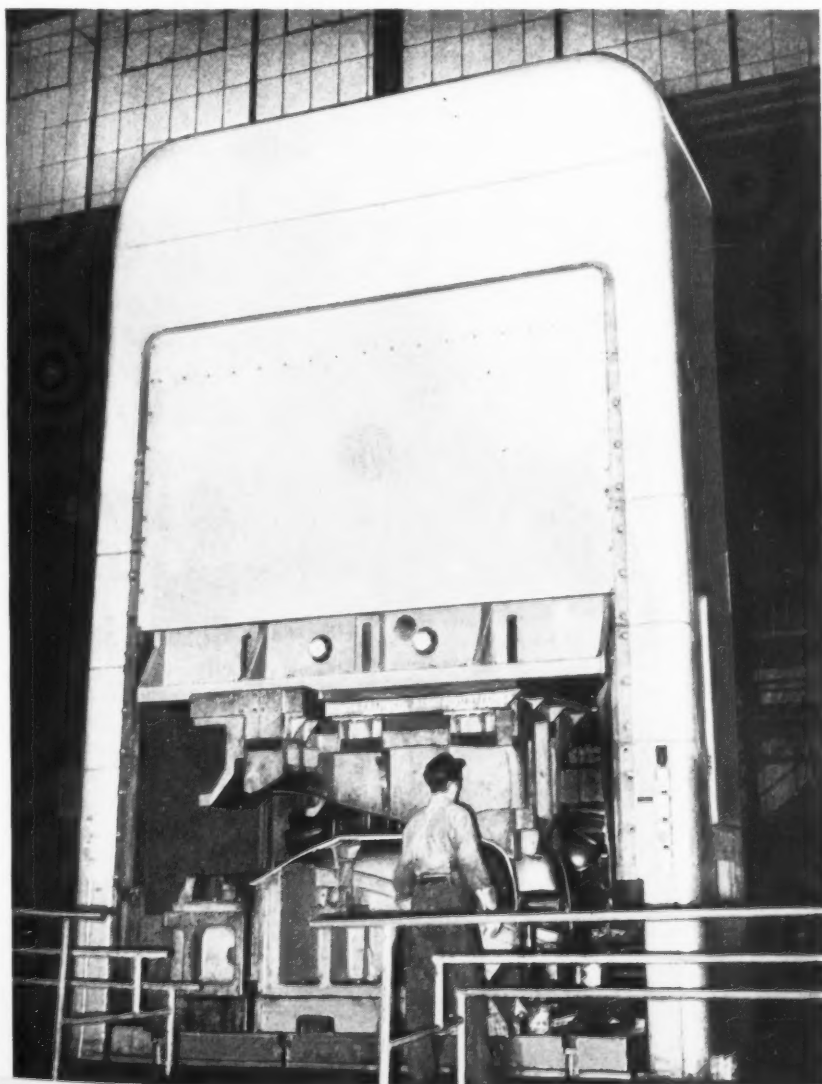
Unique Practices in Producing Oldsmobile Front Fenders

By CHARLES O. HERB

UNIQUE production methods, together with the use of power presses and welding machines of latest types, make the front fender producing line of the Oldsmobile Division of the General Motors Corporation, Lansing, Mich., an outstanding example of efficient manufacturing practice. A striking departure from conventional practice enables fenders of three sizes for different car models to be produced by the same machines. This necessitates the complete changing every night of the heavy dies used in nine presses for the drawing, forming, and piercing of the fenders, as well

as the substitution of different fixtures, the making of adjustments, and the changing of electrodes on the welding machines.

Enough fenders for Models 60, 70, or 90 Oldsmobiles are produced in one day to meet the assembly requirements of that car model for three days. The next day fenders are produced for one of the other car models, and the third day for the remaining model. This cycle is repeated continuously; it constitutes a manufacturing procedure that is closely coupled to the needs of the sales division, and eliminates the necessity of maintaining large



*Five Hundred Tons of Dies
Are Handled Every Night
in Changing over Stamping
Presses to Enable Fenders
for Three Different Car
Models to be Produced with
Minimum Stock Ahead*



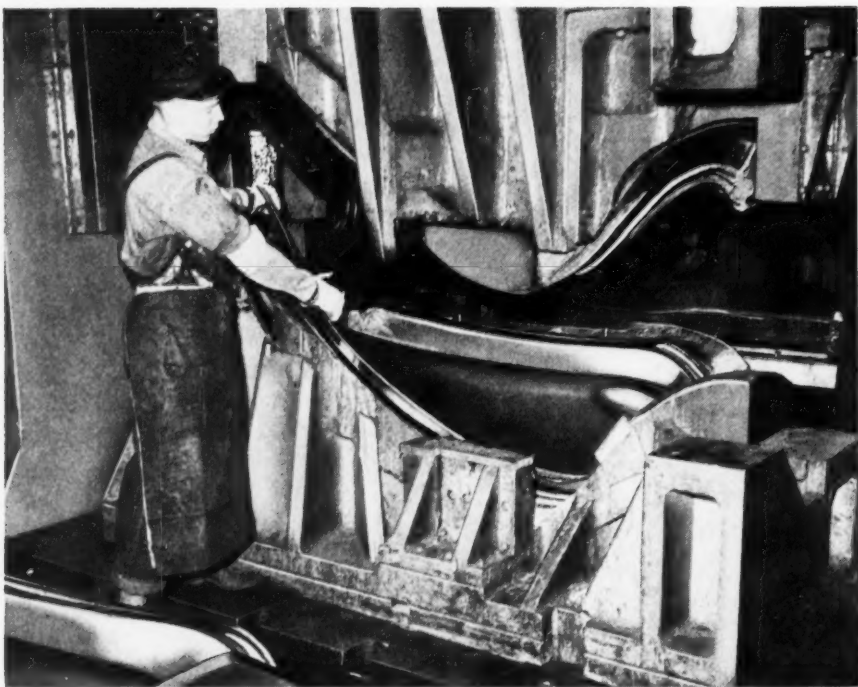


Fig. 1. Press Operation in which Oldsmobile Front Fenders are Drawn to a Difficult Contour with Little Scrap

stocks of finished fenders for the three car models produced.

All fender dies are drilled and doweled to standard lay-outs, so that the dies for the ram or bolster of all presses can be readily changed with the assurance that they will be correctly lined up. With this aligning provision and the use of a 20-ton high-lift truck, the nightly changing of the heavy dies in all nine presses and the change-over of four welding machines is accomplished within three hours. This involves the handling of 500 tons of dies between the presses and the storage section, the dies weighing from 20 to 30 tons each.

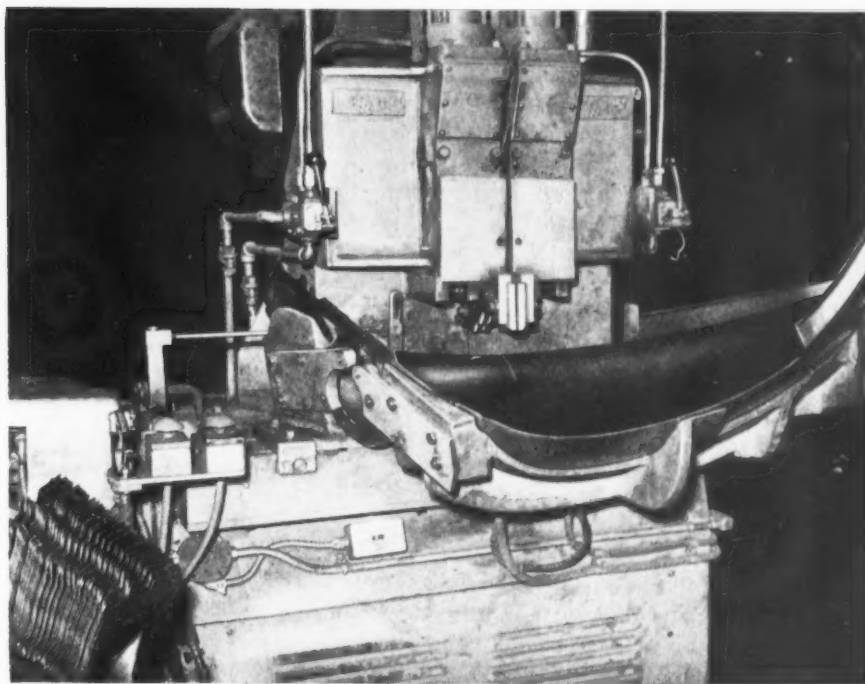
All the presses, except those used for drawing, are equipped for handling either two or four fen-

ders at a time. The drawing operation is performed in 600-ton toggle presses equipped as shown in Fig. 1, one of these presses being used for right-hand front fenders and the other for left-hand front fenders. The dies of the drawing presses are of more or less conventional design in that a blank-holder on the punch holds the edges of the blank firmly on the bottom die while an inside punch member moves downward to draw and stretch the sheet metal to the desired shape. The thickness of the metal is reduced as much as 25 per cent in this operation, whereas a reduction of 10 to 15 per cent would have been thought considerable a few years ago; annealing after drawing would also have been necessary. Advances in both die design and the



Fig. 2. Operation that Involves the Use of Punch Shears and a Die Having Shearing Slides Actuated by Cams

Fig. 3. Assembling a Head-lamp Housing Stamping to the Front Fender Stamping by Flash-welding



manufacture of sheet steel have eliminated the necessity of annealing, in addition to enabling far greater transformation of the metal.

In the drawing operation, one-half of the head-lamp housing is formed on the fender, as may be seen near the right-hand end of the work in Fig. 1. A feature of this drawing operation is the small amount of scrap, which is directly due to the exercise of extreme watchfulness in "spotting" the dies and careful operation of the press. The sheet-steel blanks measure 85 by 46 inches and are 0.040 inch thick.

Two sets of identical punches and dies, as shown in Fig. 2, trim two fenders simultaneously. In this operation, shear blades extending from front to

back along the right-hand side of the ram trim along the irregular top edge of the fender as the ram descends. At the same time, a shear at the rear of the die is pushed forward at an angle by a cam on the punch, so as to cut along the back of the fender. Also, a shear at the left is pushed toward the right at an angle by cams on the press ram to trim along the left-hand side of the fender. The scrap cut off from the fender seen in the die is shown resting against the front of the press. The shear blades on the ram cut vertically through the metal before the sliding shears are operated by the cams.

From this trimming operation, the fenders pass to the flash-welding machine shown in Fig. 3, where

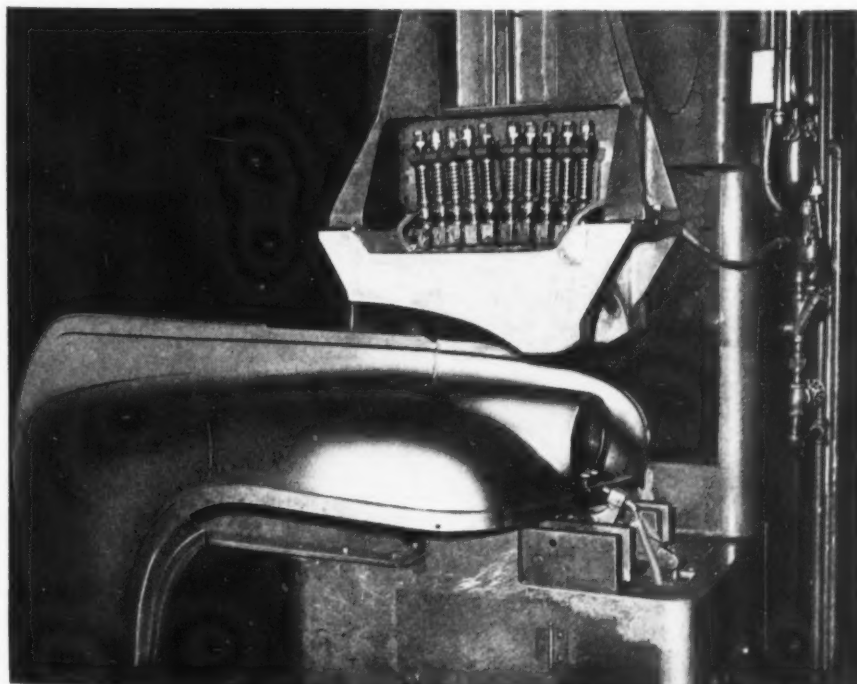


Fig. 4. Spot-welding Operation in which Eleven Electrodes are Simultaneously Applied on Fender Stampings

a small sheet-steel section that comprises the remaining portion of the head-lamp housing is welded to the fender. Two electrode heads or rams are lowered on opposite sides of the seam by the operation of hydraulic valves on the sides of the rams after strips of insulating material have been placed on each side of the electrodes to prevent the electric current from following the edges of the stampings and causing a short circuit. An electric push-button is depressed to start the welding operation.

The two electrodes are machined to the contour of the fender and the stamping that is to be welded to it. A stringent requirement in this operation is that the two electrodes must line up within 0.001 inch. A different fixture must be provided for each of the three types of fenders, and the electrodes must also be changed. Keys and corresponding keyways insure accurate mounting of the fixtures on the machine table. This welding machine has a rating of 75 kilovolt-amperes transformer capacity.

Eleven spot-welds are then made along the overlapping flanges of the fender and head-lamp stamping by the machine illustrated in Fig. 4. The fender assembly is located accurately on a fixture on the base of the machine as shown, and a head shaped to fit the contour of the fender is lowered on top by the pneumatic ram of the machine. There are ten electrodes on this head, backed up by springs that apply a predetermined pressure on each elec-

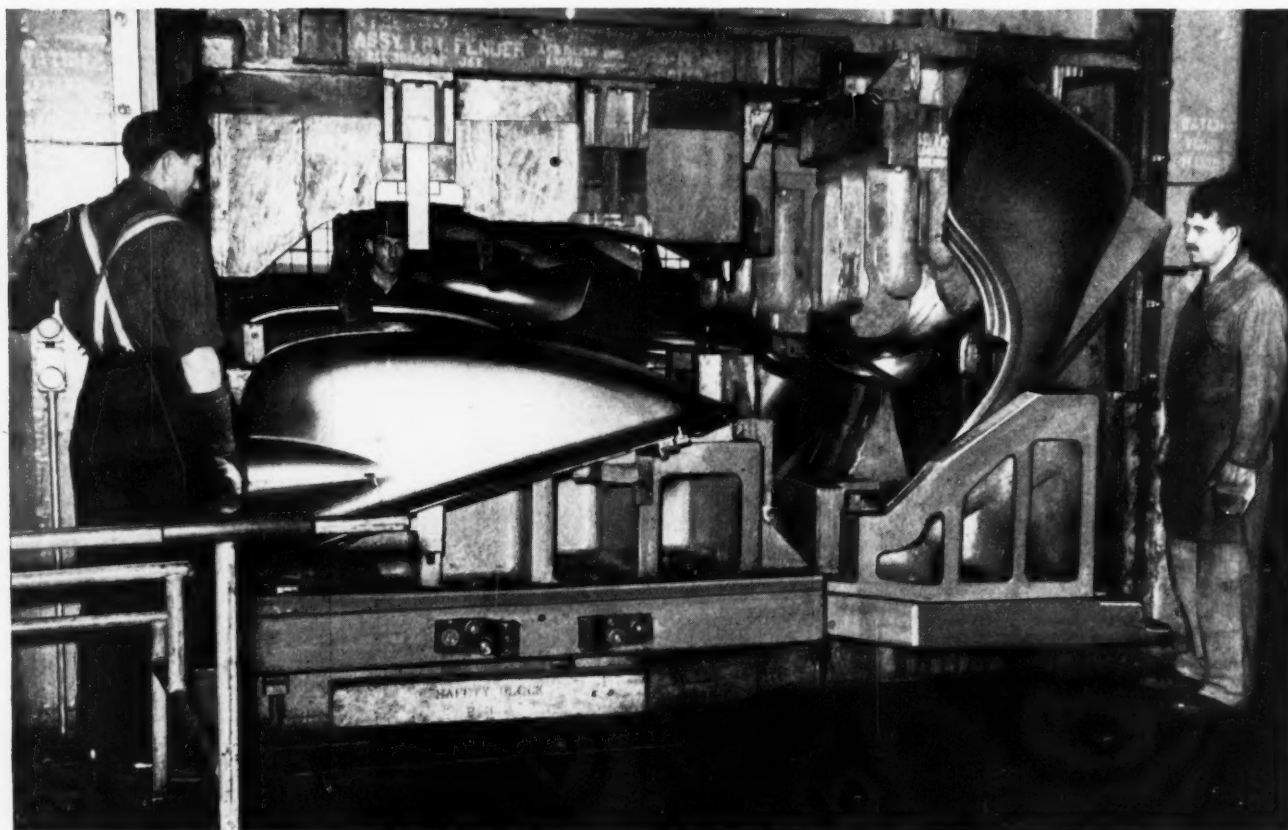
trode before the electric current is turned on for the welding operation. Another electrode at the right-hand end of the machine is rocked upward automatically by an air cylinder to spot-weld the two stampings together at the bottom of the head-lamp housing.

All the electrodes are water-cooled. They are simultaneously applied, separate transformers of 25 kilovolt-amperes each being provided for every two electrodes. Two spot-welders of this type are being used, one for right-hand and the other for left-hand fenders, which is also true of the flash-welders.

After a combined trimming and flanging operation performed on a power press of typical construction, the fenders reach a line of presses of the type seen in the heading illustration. These presses are of the two-point crank type, of cast construction, with a completely enclosed top, and each has a rating of 450 tons. Four fenders are handled at a time in some of these presses, and two in the others.

In the first of these machines, of which a close-up view is shown in Fig. 5, a combined restriking and embossing operation is performed on the head-lamp housing of two fenders at the front and back of the press on the right-hand side, and at the same time, two fenders at the front and back of the press on the left-hand side are being trimmed and flanged

Fig. 5. Four Sets of Dies Provided on This Press Enable Restriking, Embossing, Trimming, and Flanging Operations to be Performed Simultaneously on Right- and Left-hand Front Fenders



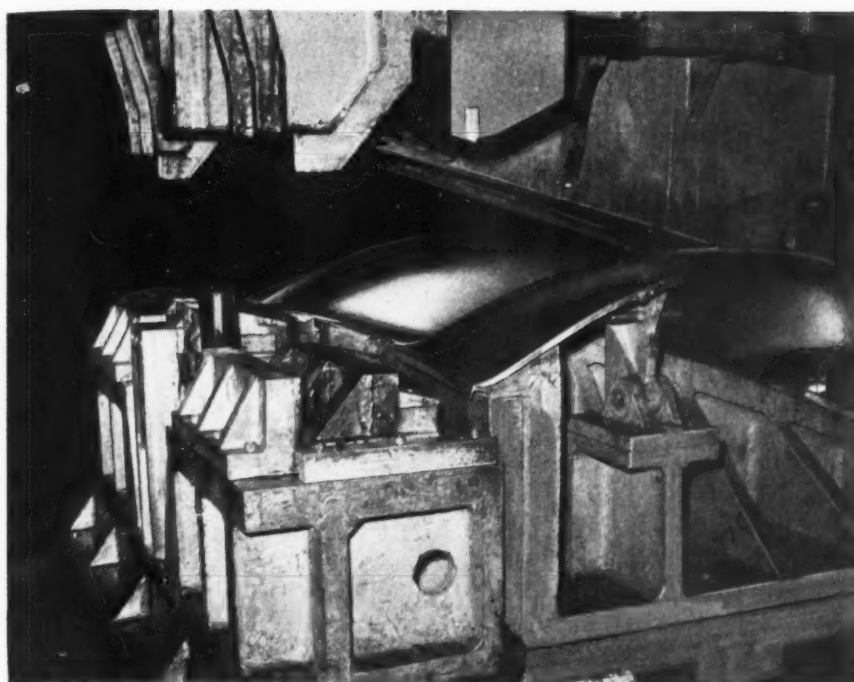


Fig. 6. Press Operation in which a Slide is Operated Horizontally by a Cam on the Ram to Bend an Edge of the Fender Underneath a Ledge on the Main Die

along the wheel housing opening. In this operation, all movements of the punches are downward in true vertical planes and the dies are made without any moving sections.

The next operation consists of forming the hood sill and the cowl flange. This is performed in dies of the type shown in Fig. 6 of which there are two on the press, one at the front and the other at the back, for handling right- and left-hand fenders. There is a slide on the left-hand side of the front die that is moved horizontally to bend the cowl flange under a ledge on the stationary main die-block. This slide is actuated by the inclined surface of a cam attached to the punch member. In the middle of the main die, there is a swiveling

member that is swung upward into a vertical position to support an overhanging portion of the fender.

The third press restrikes the hood sill, forms a flange along the front of the fender, and re-flanges the bottom of the head-lamp section. When the ram of the press descends, a slide, such as seen at the right in Fig. 7, is moved horizontally toward the left by the inclined surface of a cam on the ram. As this slide advances, cams keyed to the bottom of the slide cause a second slide to rise from the press bolster underneath the work.

This vertical-moving slide actuates a second horizontal slide in the opposite direction to the movement of the first horizontal slide. The second



Fig. 7. Close-up View of a Die in which are Incorporated Horizontal Slides that Move toward Each Other and a Vertical Slide that Actuates One of the Horizontal Slides

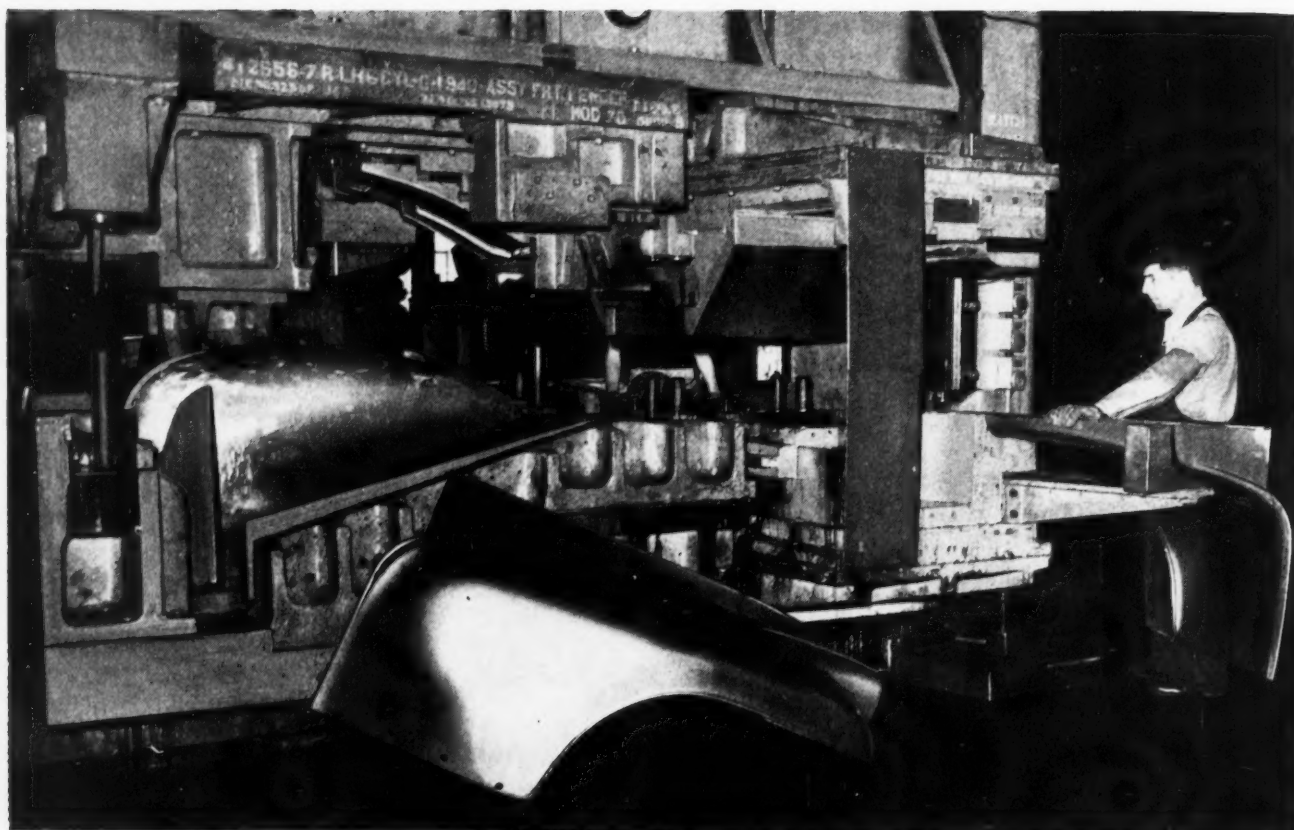


Fig. 8. Equipment Provided on a Press that Pierces All of the Holes in Right- and Left-hand Front Fenders and also Performs a Trimming Operation

horizontal slide dwells after it has moved forward a distance of about 4 inches, while the first horizontal slide continues advancing and bends the edge of the fender under a ledge on the opposing slide. A cam seen on the ram assists in pushing the second horizontal slide toward the right. No fender was in the die at the time that the photograph shown in Fig. 7 was taken, so that the arrangement of the slides could be readily observed.

Four fenders are handled at a time in the last press operation, which pierces a large number of holes in both right- and left-hand front fenders. This operation is shown in Fig. 8. Again, identical sets of dies and punches are provided at the front and back of the press. Holes are pierced around the front of the head-lamp housing and molding holes on top of this housing by the die equipment at the right. When the ram descends, a cam pushes a slide forward to pierce the holes in the front of the head-lamp housing at the same time that the molding holes in the top are being pierced by overhead punches.

The dies at the left pierce holes along the bottom edge of the fender, as seen by the example lying at the front of the bed, and also perform a final trimming operation. A heavy slide at the front of the press on the left-hand side is pulled inward by two cams on the ram for this operation, at the same time that a rear slide is pushed forward, also by cams on the ram.

The entire front-fender press and welder line-up is arranged to handle 270 fenders an hour. Quick handling of the fenders is facilitated by the use of inclined racks, made from pipe, that extend from press to press, as seen in the heading illustration.

* * *

Tool Engineers Plan Meeting in Cincinnati

The American Society of Tool Engineers, with headquarters at 2567 W. Grand Blvd., Detroit, Mich., is planning to hold its semi-annual meeting in Cincinnati, Ohio, October 17 to 19. As the keynote for this meeting, the Society has chosen "Tooling with Men and Machines for National Defense." The three-day program includes both technical sessions and inspection trips to machine tool and production plants in the Cincinnati area.

One of the subjects to be brought before the convention will be a symposium "Should Industry Assume the Burden of Special Education?" at which various viewpoints on the question will be presented. The subject of the dinner meeting on October 18 will be "Aeronautical Preparedness." The technical program will also include a symposium on gear production methods to which a great many well-known engineers of broad experience in that field will contribute.

An Industrial Application of Electrically Cleaned Air

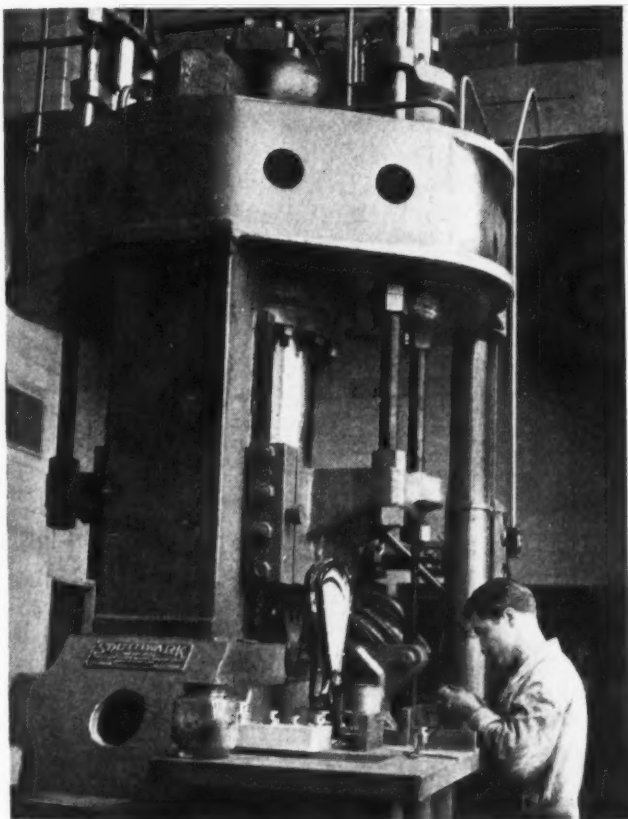
The Use of the Precipitron—A Device that Cleans Air Electrically—Has Materially Reduced Rejections in Making Sintered Carbide Tools

By W. J. LOACH, Manager, Firthite Department
Firth-Sterling Steel Co., McKeesport, Pa.

IN the manufacture of sintered powdered metals for tools and dies, it is of great importance that there be no dust particles in the room in which the work is performed. Any foreign particles, irrespective of size, that mix with the powdered metal before it is pressed into shape will burn in the compressed piece during sintering and will leave a maze of minute holes. A tool or die made of such metal must be scrapped.

When the new Firth-Sterling plant for the manufacture of sintered carbide tools was designed,

cleanliness was one of the most important factors influencing both the architectural and the industrial lay-out. Terrazzo floors, Carrara glass walls, and linoleum ceilings were used, so that the whole inside of the building could be easily and quickly washed. Windows were sealed tightly, and ventilating air was brought into the building through a carefully designed system of ducts. For cleaning the air, two banks of spun-glass mechanical filters were installed so that all air brought into the building was passed through them in series.



A 400-ton, Two-way, Hydraulic Press in which Metallic Powders are Compressed into Blanks before Sintering. In This Process, Cleanliness is of Paramount Importance



An Electrostatic Air Cleaner Removes Dirt from the Air, which had Previously been Carried into the Room, Causing Many Rejections of Sintered Carbide Tools and Dies

Despite these precautions, when production was started two years ago, the number of rejected tools traceable to foreign particles in the air was entirely too great. A check-up on the air filters showed that a large volume of dirt was being removed, composed chiefly of particles of soot large enough so that they could be seen with the naked eye. However, a microscopic analysis of the filtered air disclosed thousands of minute particles, mostly carbon soot and silica dust, which were passing through the mechanical filters and being carried into the powdered metals department.

On a weight basis, these microscopic particles probably comprised a relatively small part of the air-borne dirt. Obviously, adding more filters in series would not solve the problem as the small particles would still pass through. With only a few simple changes in the duct, however, a Westinghouse electrostatic air cleaner, known as the Precipitron, was installed in the air duct running from the central ventilating system to the powdered metals department, and almost immediately the rejections were reduced to a negligible quantity.

The principle upon which the Precipitron operates is relatively simple. A fine tungsten wire, situated between two grounded electrodes, is charged at a direct potential of 12,000 volts, and thus creates a strong electrostatic field in the space surrounding it. As air passes through this electric field, each tiny particle receives an electric charge of a definite polarity. These charged particles keep moving, in the direction of the air flow, into a chamber known as the collector cell, which contains parallel metal plates spaced about 5/16 inch apart. These plates are charged alternately, positive and negative, at a potential difference of 5000 volts. Since like charges repel each other and unlike charges attract, every foreign particle in the air being charged is attracted to one of these plates and held to it by adhesion. Sooty particles may be greasy enough to adhere by themselves, but to hold silica dust and other particles, the plates sometimes require an auxiliary adhesive coating.

The air cleaner installed in the Firth-Sterling plant consists of two cells, each having a normal cleaning capacity of about 650 cubic feet of air per minute. They are operated at slightly less than their full capacity with some gain in efficiency. The intake is 1200 cubic feet per minute at a cleaning efficiency of about 95 per cent, as measured by the "blackness test" method specified by the National Bureau of Standards. The heated air duct is run in at the bottom of the unit and clean air is distributed from the top.

The maintenance of the equipment is simple, requiring the shut-down of the device for only about thirty minutes a week. At this time, both cells are completely removed, flushed with water, dipped in a mild alkaline solution to remove greasy deposits, and then sprayed with a simple adhesive substance and replaced. The mechanical filters, which are still used effectively ahead of the electrostatic cleaner in this system, and which remove the larger particles, are replaced every two weeks.

The Recent Cleveland Shop Equipment Show

The exposition organized by Grob Brothers, Grafton, Wis., in the Cleveland Public Auditorium, Cleveland, Ohio, June 25 to 29, known as the Production and Machine Tool Show, offered an opportunity for a number of machine tool builders, as well as shop equipment and tool manufacturers, to present their products to mechanical executives.

One of the more unusual exhibits was the new Grob impact briquetting machine, manufactured by Doelger & Kirsten, Inc., Milwaukee, Wis. A new type of press was exhibited by the V & O Press Co., Hudson, N. Y. Grob Brothers had a representative line of their machines exhibited, as did also the Dumore Co., Racine, Wis., and the Porter-Cable Machine Co., Syracuse, N. Y. Die milling, drilling, and boring machines were shown by the Jackson Machine & Tool Co., and Blank & Buxton Machinery Co., both of Jackson, Mich. The Delta Mfg. Co., Milwaukee, Wis., exhibited an extensive line of drilling machines. The Hamilton Mfg. Co., Two Rivers, Wis., exhibited drafting tables. The Ford Motor Co., Gage Division, Dearborn, Mich., exhibited its line of gage-blocks and gages, and the Parker-Kalon Corporation, New York City, a great variety of screws and similar products.

Other exhibitors of shop equipment were: Henry P. Boggis & Co., Cleveland, Ohio; Cassels Engineering & Machine Co., Wauwatosa, Wis.; Clark Tractor, Battle Creek, Mich.; C. C. Craley Co., Shillington, Pa.; Eastern Cutter & Salvage Co., Newark, N. J.; Fulton Foundry & Machine Co., Cleveland; Mall Tool Co., Chicago, Ill.; Master Chrome Service, Cleveland; Master Tool Co., Cleveland; A. Schrader's Son, Brooklyn, N. Y.; Smith Power Transmission Co., Cleveland; Sunnen Products Co., St. Louis, Mo.; Wells Mfg. Corporation, Three Rivers, Mich.; and the Weatherhead Co., Cleveland.

* * *

Machinery Exports Continue at High Level

The exports of industrial machinery from the United States during the month of May, the last month for which complete statistics are available, amounted to \$36,680,000, which is 41 per cent above the exports for May, 1939, according to the Machinery Division, Bureau of Foreign and Domestic Commerce, Washington, D. C. The shipments of power-driven metal-working machinery were valued at \$19,140,000—65 per cent above the May, 1939, exports.

* * *

Tom L. Johnson, for several terms mayor of Cleveland, when asked what constituted a good executive, said: "To grasp the facts instantly, to decide quickly, and to be right more than 50 per cent of the time."

A Coordinated Training Program that Has Produced Results

An Outline of Principles Involved and the Methods Followed in the Training Program Developed by the Warner & Swasey Co. with the Aim of Fitting Men to Take Their Place in the Mechanical Industries



The First Step toward a Successful Future in the Mechanical Industry — Applicant being Interviewed

ONE of the most serious problems confronting the mechanical industries at this moment is the scarcity of skilled men capable of operating the machines and turning out the products demanded of industry throughout the nation. There is a need for machine operators who can successfully handle one or two machines, for skilled all-around machinists and toolmakers, and, finally, for men with thorough mechanical training able to fill supervisory and executive positions.

The Warner & Swasey Co., Cleveland, Ohio, a pioneer in the design and building of turret lathes, has developed a training program in which the requirements all the way from the semi-skilled machine operator to the thoroughly trained mechanical executive are taken care of. Briefly, this program coordinates the training of four groups of men, each of which is trained with a definite objective in mind. These groups are classified as (1) learners, (2) regular apprentices, (3) special apprentices, and (4) technical apprentices.

At the moment, the greatest interest centers about the "learners," since the scarcity of properly trained machine operators has made it imperative that large groups of qualified young men be taught quickly to fill their place in industry. This is accomplished by setting as the objective, not the training of an all-around machinist, but rather of a man who can satisfactorily operate one type of machine tool or perform some one operation in the assembly department, as, for example, scraping.

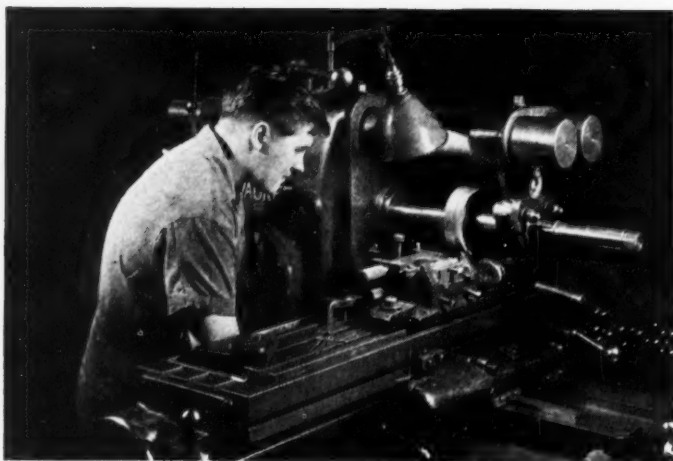
The plan for definitely training learners as a group was inaugurated by the Warner & Swasey Co. in 1935. Since then, approximately 1000 men have been hired for such training, of whom already about 500 have become semi-skilled operators, most of the remainder now being in the training course.

Approximately 400 have been added to the payroll since last September, when the demand for semi-skilled men in machine shops became especially pressing.

Of the men hired as learners since May, 1935, there are 82 per cent still in the company's employ. Owing to the great care with which these men are selected before they are placed in training, only three out of every hundred have been found unsuitable for the work for which they had been selected.

The secret of the success of this training plan may well be said to be the extreme care with which the learners are selected. With few exceptions, all the learners are from nineteen to thirty years of age. Two-thirds of those hired are selected from among the graduates of vocational high schools, thus assuring that they have some previous mechanical training, understand the character of mechanical work, and have an aptitude and liking for it. The other third is selected from applicants who have some machine shop background—for example, those who have worked for some time in another shop. Most of the applicants are obtained through vocational high-school placement bureaus, and come recommended by the school authorities.

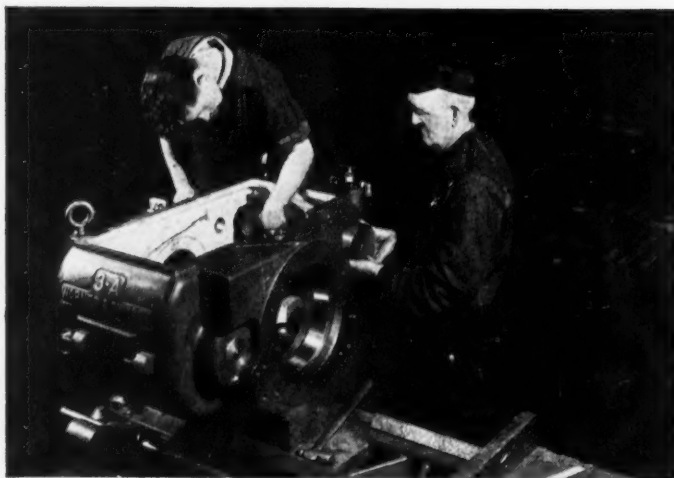
The learner is put to work directly under the authority of the foreman of the department, but receives most of his instruction from an older employe, also carefully selected, who teaches him the operation of the machine on which he, himself, is working. There is no fixed time of training. The period may vary from two to five months, depending upon the ability of the young man and the rapidity with which he acquires the necessary skill. During the training period, the foreman reports on the learner's progress once a month. At the end of the learning period, the young man is transferred



A definite period of time is spent by the apprentice in the operation of each type of machine. He devotes four months to learning to operate all types of milling machines, and approximately one month each to horizontal, vertical, duplex, and hand milling machines.



Obviously, since the company manufactures turret lathes, special emphasis is placed on a thorough understanding of the construction and operation of this type of machine; hence, eight months are devoted to the operation of turret lathes—both ram and saddle type.



Ten months are devoted to the work in four different assembly departments. The young man becomes familiar with the assembly of the various sub-units of the turret lathe before he works on the assembly of complete machines. He is always guided by a competent instructor.



The young men spend four months in the tool-room, where they get a variety of work on shapers, milling machines, and lathes, as well as bench work. They are also thoroughly instructed in taking accurate measurements on tools and fixtures for precision work.

to the semi-skilled workers' classification, and is automatically given the pay accorded to that class of workers.

Fitting Young Men to Become the Supervisors of the Future

The Warner & Swasey Co. was founded by two men who, themselves, had served regular apprenticeships in New England. One of their first acts after establishing a business of their own in the early eighties was to start an apprentice system. The first apprentices were indentured in 1882, and one of them is still a valued member of the Warner & Swasey organization. A great many of the foremen in the plant today served their apprenticeship with the company.

In the early years—and until quite recently—the apprentice course was designed chiefly to produce all-around machinists and toolmakers. Following the war period, the apprentice courses were greatly amplified; but it was not until after the recent business depression that the basic plan was altered.

In industry today, the requirements placed upon foremen and others in supervisory positions are much greater than in the past. In the old days, if a man was a capable worker (and stood in well with the boss), he was likely to be made foreman, with little regard to his education and background. Today, the foreman occupies a far more important position in the industrial set-up. He is the representative of the management; and in addition to his skill as a worker, he requires judgment, tact, and a broad conception of industrial relations. Hence, today, the regular apprentice training course is aimed specifically at the training of men to occupy supervisory positions. The young men entering this course are from seventeen to nineteen years of age and are recruited chiefly from the technical high schools. They are destined to become foremen, inspectors, assistant superintendents, production and routing men, draftsmen, assistants to department heads, etc.

Since the inauguration of the Warner & Swasey apprentice school, about 380 men have graduated. Of these, 115 are still in the employ of the company, holding positions of responsibility. At present, 60 boys are enrolled in the regular apprenticeship course. Since the course is of four years' duration, this means that approximately 15 are taken in every year, while an equal number graduate. As a rule, more than a dozen boys apply for every one that is selected and started on his apprenticeship.

In this case, as in the case with learners, great care is exercised in selecting the young man. First of all, he must have his diploma from an accredited high school. Each applicant must also, before he is interviewed, present a letter from the principal or placement director of his high school recommending him, not only from the scholarship standpoint, but also from the point of view of character and family background. While regular high-school

graduates are eligible, about three-fourths of those selected have graduated from a vocational high school; but in every instance, the applicant must show evidence of mechanical ability.

The young man is interviewed separately by each of a committee of four. The applicant is given a searching verbal examination to determine his fitness for appointment. The first of these interviewers talks to all of the boys. He eliminates those who seem least suitable and passes the others on to the next interviewer, and so on.

During the interview, an effort is made to learn something about the young man's mechanical adaptability and to determine whether he really likes this kind of work. The extra curricular work that he has done is looked into. Through conversation, the interviewer learns what he usually does with his spare time. If he has been a boy scout or engaged in similar activities, this is noted. His father's occupation is taken account of, and some inquiry is made with regard to his family. Finally, the interviewer notes what general impression the boy makes.

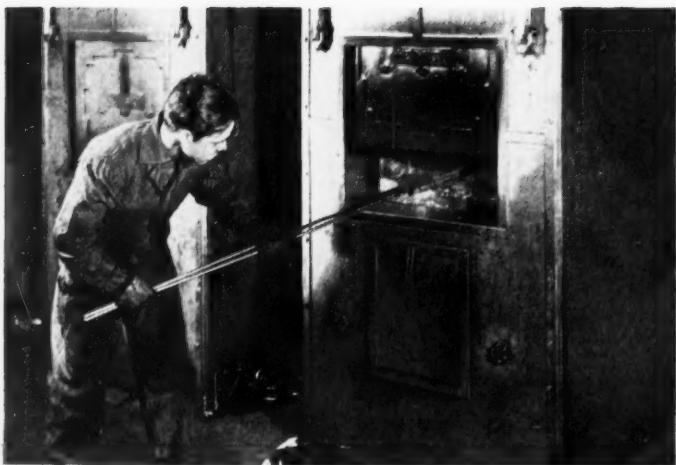
Although placed on probation for a period of six months, it is very rare that a young man has to be dismissed at the end of that time; yet occasionally this happens. It is preferable, however, to make the entrance requirements so severe that the successful applicant is almost certain to prove acceptable. The six months' probation period is counted as part of the four-year apprenticeship course.

Instruction that the Young Man Receives

The apprentices attend school on the company's time, four hours a week. They are also required to take night school courses of their own selection, subject to the approval of the supervisor of training. Most of the young men choose wisely and require very little supervision in this respect. The company also sponsors a series of one-hour lectures by department heads and engineers. Two-thirds of these lectures are devoted to functions of the departments, and the other third to topics of an engineering nature. The young men attending these lectures are required to take notes and to write papers on the lectures, on a competitive basis. At the end of the course, the three young men with the best records are rewarded in the form of a one-week trip to manufacturing establishments in some other city.

The apprentices are kept at work on a truly productive basis, as far as possible, from the very beginning. Now and then, over a period of years, when current orders did not meet the current training needs, hypothetical jobs were invented for the apprentices to give them the required experience; but only a small amount of non-productive work has been necessary.

The experience has been that the apprentices not only learn quickly to become good operators, but that they can be used in a surprisingly short time on a wide assortment of jobs throughout the plant,



Two months are devoted to work in the heat-treating department. At this time, the young man is in his last year and works with an experienced hardener. He thus obtains a thorough knowledge of the functions of this important department.



According to the aptitude of the young men, they spend the last four or six months of their apprentice course in the department for which they seem best fitted. It may be, as in the case here illustrated, in the final inspection department of turret lathes.



Other young men may spend the last few months of their training course in the drafting-room, doing detail drafting, special tool design, or work of a similar character. In this manner, they often find their way later to responsible positions.



Those who have given evidence of their aptitude in that direction, are given a few months' training in cost estimating, in the order department, and in the sales department. Some of these men develop into capable salesmen, with a complete, practical background.

so that they may be transferred to routing and planning, to the drafting-room or sales organization, and to the designing, engineering, and even advertising departments, during the last months of their training period.

Provisions for Special Apprentices

The group known as "special" apprentices consists of young men who appear to have real promise, but who do not fit naturally into any particular classification. For instance, a special apprentice may be a machine operator who has shown unusual capacity for advancement or a young man who has graduated from a college of arts and sciences, but who has learned later that he should not have attempted to become a professor of English, as he is much better fitted to go into the industrial field. A special apprentice may also be a man who has attended an engineering college, but who, for various reasons, was unable to complete his course and had to drop it before graduation.

In other words, each of these men represents a special case. Each one has shown certain abilities, but lacks something in the way of training and education. It has been found that by supplying these lacks, a valuable source of personnel material has been uncovered.

Almost all the men coming under the heading of special apprentices need certain additional educational courses, varying for each case. A plan is, therefore, worked out to fit each individual. The amount of additional education required is usually not as great as in the case of regular apprentices; the degree of adaptability is also usually somewhat higher. Therefore, the apprentice period for the special group is shorter. This course is set up on the basis of twenty-one months.

The most advanced part of the apprentice training plan is provided for what are known as "technical" apprentices. This group consists entirely of graduates of engineering schools, such, for example, as Cornell or the Massachusetts Institute of Technology. It is assumed that these men have had all the regular classroom work required. What they need is purely practical training in the shop and office. They start like all the rest of the apprentices in the shop, learning how to operate machine tools. Then, like the other apprentices, they pass on to other work. They, in common with the regular and special apprentices, attend the lectures given

by the executives. But because they have a broader background, the length of training need not be so long. The technical apprentices, therefore, complete their work in eighteen months. In this course, there are usually from sixteen to twenty men enrolled.

It should be noted, in reviewing the four different types of training provided, that each type is fitted to the specific needs, not only of the business, but of the young men being trained. The entire training program is coordinated to fill the needs of an industrial enterprise for mechanical executives, supervisors, and machine operators. One evidence of the success of this system may be found in the fact that not only are a large percentage of the supervisory positions filled with men who have been trained by the company, but also a large proportion of the present machine operators have had their training within the plant. This, in turn, has enabled the company to rapidly expand its operations and working force at this time, when such expansion has become highly necessary.

The officials of the Warner & Swasey Co. point out that there is no lack of young men eager to receive training for useful work. The boys coming out of our schools today are just as smart, just as adaptable and just as eager, as were the boys of not so many years ago, and far better educated. It is for the manufacturer to devise ways and means of training these boys rather than complain that there is a deplorable lack of skilled workers, which prevents him from expanding his plant operations.

A great deal is said today about the lack of opportunity for young men. As a matter of fact, any careful observer who knows the past and the present recognizes that there is more opportunity for young men today than ever before; and with proper guidance, it is also true that the young men of today are no less eager to grasp their opportunity than were those of a generation ago. All that industry has to do is to prove to the young man that it is offering him an opportunity that will lead to a practical and substantial development of his abilities.

* * *

The Hobart Brothers Co., Troy, Ohio, is erecting a new trade school building to house what is to be known as the Hobart Trade School—a two-story structure 90 by 60 feet. The new school, to be ready in the fall, is expected to provide complete training in machine shop practice and arc welding.

The final step in the apprentice course. The young man receives his diploma from the president of the company.



Performing Broaching Operations in Foot and Power Presses

By M. J. GOLDSTEIN

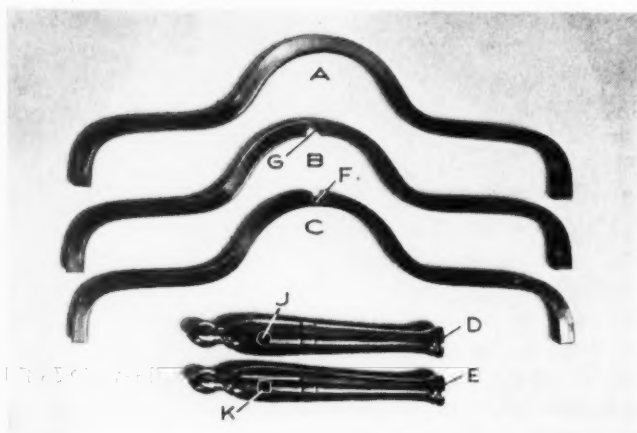


Fig. 1. Formed and Broached Parts of Candelabra Shown in the Heading Illustration

WHILE the power press is sometimes used for broaching, practically all operations of this kind that the writer has observed have been more like shaving operations. In most cases, the operations simply "size" pieces previously punched out by other dies. Some time ago the writer made up the tools for producing a line of candlesticks and candelabra that included several broaching dies of interesting design. One set of

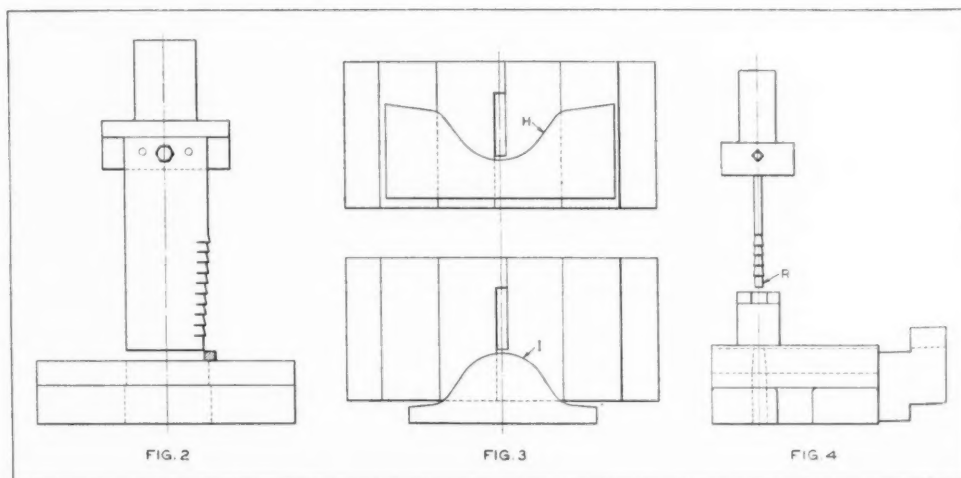
dies for broaching the slots in the arms of the candelabra shown in the heading illustration was designed for use in a power press, while another die, designed for squaring the drilled hole in a candlestick column, was adapted for operation in a foot press.

The arms to be broached were first formed from 5/16-inch square soft brass stock to the shape shown at A, Fig. 1. This operation was performed in the power press, the die being made of cold-drawn steel, pack-hardened. The complete bend was made in one operation.

The broaching die for producing the notches F and G, Fig. 1, is shown in Fig. 2. The die is of a simple sectional type, the opening for the broach being 0.312 inch wide by 2 inches long. The broach itself is oil-hardened steel, and is fastened to a steel shank by a 3/8-inch cap-screw and two dowelpins. This broach has ten teeth. The first four teeth remove 0.018 inch of metal each, the next five teeth 0.015 inch each, and the last tooth 0.010 inch.

In Fig. 3 are shown the top views of the die with the two locating gages H and I in position. These gages are of cold-drawn steel, 1/4 inch thick, and are securely held in place by screws and dowels. The brass arms to be broached are placed in position on the die. The downward pressure of the broach forces the work against the gage H or I,

Fig. 2. Broaching Die for Producing Notches F and G, Fig. 1. Fig. 3. Top Views of Broaching Die, Showing Locating Gages I and H Used in Cutting Notches F and G. Fig. 4. Die Used to Broach the Round Hole J, Fig. 1, to Square Shape Shown at K



depending on whether notch *G* or *F*, Fig. 1, is being broached.

It was found that best results were obtained by passing the broach through the work twice, in order to compensate for the slight "spring" due to cutting pressure. Half of the pieces are broached with gage *H* in position, and the other half with gage *I* in place. When crossed, the broached pieces form the lower arms of the candelabra.

In Fig. 5 is shown the die used for broaching slots in the upper arms. This die produces the slots in 1/4-inch square brass stock, and is similar in construction to the die employed for notching the lower arms.

Another broaching die is shown in Fig. 4. This die is used to broach a square hole in the brass column *E*, Fig. 1, as indicated at *K*. The column is first drilled in a jig with a 17/64-inch drill, as

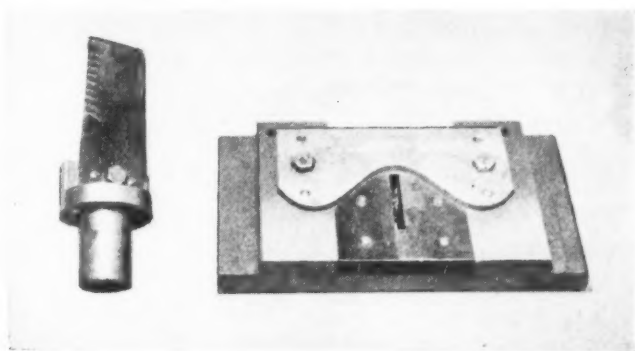


Fig. 5. Die for Broaching Notches or Slots in Upper Arms of Candelabra

indicated in the view at *D*, after which the drilled hole *J* is broached to the square shape shown at *K* in a foot press. The top face of the die used for this operation has a groove formed to a radius of 3/8 inch for locating the work. There is also a support for the outer end of the column which insures broaching the drilled hole at right angles to the longitudinal axis of the work. The hole is lined up by bringing the round end of the broach, shown at *R*, Fig. 4, down into the hole. Continued pressure forces the square part of the broach through the hole, forming it to the square shape.

The foot press and power press broaching dies are essentially alike. Both remove the metal in easy steps, and give the accuracy and finish required. The power press broaching die eliminates the necessity of tying up a large milling machine for the slotting operation, and of providing an 8-inch milling cutter, which would be required to allow the arbor to clear the ends of the larger size arm.

* * *

According to the Carboloy Company, Inc., Detroit, Mich., the production of cemented carbides for tools designed for steel cutting increased nearly fourfold for the second quarter of 1940, compared with the same period in 1939.

Developments in Welded Fittings

So gradually have new developments come about in the field of welded fittings that few users are aware of the improved types now available and their problem-solving applications. Some of these new developments were pointed out in an address by E. Hall Taylor, vice-president of the Taylor Forge & Pipe Works, Chicago, Ill., before a recent convention of the International Acetylene Association at Houston, Tex.

Of first importance to users is the new "Proposed Standard for Welding Fittings," which covers the over-all dimensions and specifications of fittings in elbows, tees, caps, reducers, return bends, and lap-joint stub ends. For example, the angle of bevel for butt welding has been changed in the new standard from 45 to 37 1/2 degrees, resulting in a saving of welding time and material.

Small-diameter pipe (2 inches and under) has always presented a difficult problem in lining up and welding when beveling has to be done directly in the thin wall. The use of socket fittings is now good practice, and permits easy centering and the employment of a fillet weld which prevents the danger of burning through.

Formation of expansion loops can now be readily accomplished with the aid of welded fittings. Cutting pipe to length and attaching it by means of welded fittings is all that is required to make the loop. The elbows serve as flexible pivot points, and expansion is absorbed by flexing of the pipe.

Butt-weld flange design has been so improved that there is no danger of the welding heat warping the face of the flange. Elbows are now marked with center lines as reference points to aid in determining the angle at which the elbow is to be placed for connection to the next run of piping.

A new self-aligning fitting has been developed with an integral centering ring which assures accurate alignment without leveling or shimming. In addition, this ring stops weld metal from flowing inside the pipe, thus forming obstructions, and tends to force the weld metal well down into the bottom of the bevel, assuring complete penetration.

* * *

Motion Picture Showing Tool and Die Milling Operations

The Kearney & Trecker Corporation, Milwaukee, Wis., has completed a motion picture in color of the company's recently developed rotary-head tool and die milling machine. This picture shows the various features of the machine in a clear and simple manner, and illustrates a number of unusual milling operations performed on this machine. The film provides a means for demonstrating this machine under circumstances when an actual machine is not available for demonstration purposes. It also clearly indicates how useful motion pictures can be made in industrial work.

Engineering News Flashes

— The World Over —

Installing a Power-Generating Unit without Concrete Foundation

For the first time in this country, a large power-generating unit has been installed successfully without a concrete foundation, according to the Korfund Co., Inc., Long Island City, N. Y. A 150-H.P., four-cylinder Diesel engine, operating at 720 R.P.M., is mounted on Korfund steel spring Vibro-Isolators and Vibro-Stabilizers, installed to eliminate the necessity for a concrete foundation. By this means, the transmission of vibration from the engine was entirely stopped, so that it could be operated satisfactorily in a congested metropolitan district.

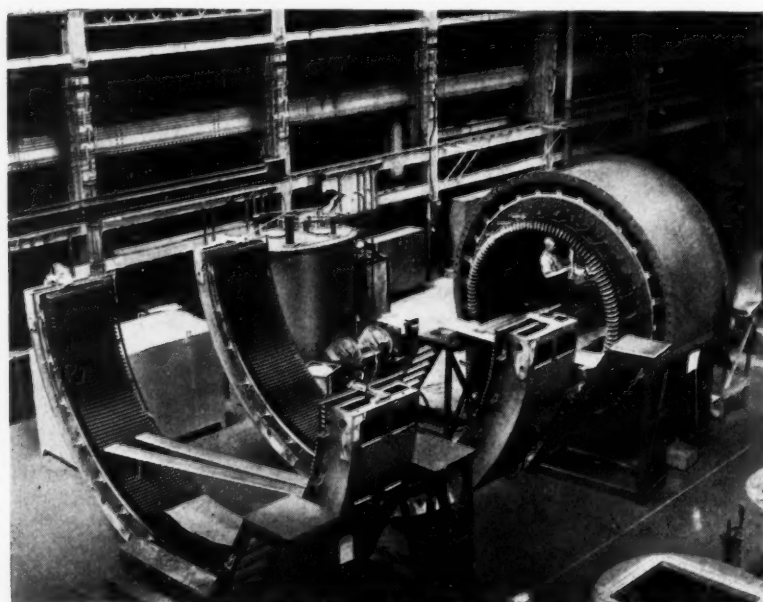
Relative Cost of Diesel-Engine Ships and Steamships

It has often been said that the first cost of Diesel-engine ships is much greater than that of steamships, but that the increased cost is justified because of the simplicity and reduced cost of operation of the Diesel-engine ships. Figures recently published, based on actual bids submitted to the United States Maritime Commission for the building of large-sized cargo vessels, indicate that the cost difference is not so great as has generally been thought. The comparison covers sixty-two ships. In the case of

five ships, the cost of the Diesel-engine ship was about 9 per cent greater than that of a steamship. In the case of eleven ships, the increased cost was from 4 to 7 per cent. Fourteen ships came within the range of 2 to 4 per cent. Seven ships came within the range of 1 to 2 per cent, while for twenty-five ships, the difference was less than 1 per cent. This comparatively small difference helps to explain why during recent years Diesel-engine ships have gained to such a great extent over ships provided with steam engines.

GE Series-Capacitor System Improves Power Factor in Welding

The widespread increase in the use of resistance welding has led to its application in the fabrication of larger and larger parts. This gradual development has tended toward increasing the size of welding machines, which, in turn, has introduced the problem of power supply to welders. As an aid and possibly a solution to this problem, the General Electric Co., Schenectady, N. Y., has developed a new series-capacitor system consisting of a capacitor equipment connected in series with the transformer primary of the resistance welding machine, and of the proper rating to improve the power factor of the welding circuit to approximately unity. This equipment can be applied to spot, pro-



The Two Giant Half-cylinders of Steel and Copper in the Foreground when Assembled will be the Stator for a Huge Water-wheel Generator Built at the East Pittsburgh Works of the Westinghouse Electric & Mfg. Co. In the Background is Shown the Stator of a 60,000-K.V.A. Synchronous Condenser

A Huge Runner for the 115,000-horsepower Hydraulic Turbines Recently Built in the Milwaukee Shops of the Allis-Chalmers Mfg. Co. for the Boulder Dam Development. This Runner Has an Outside Diameter of Over 14 Feet and Weighs 70,000 Pounds. When in Operation, a Point on the Outer Diameter of This Runner will Travel at a Speed of 92 Miles an Hour, or about 800,000 Miles a Year—Over Three Times the Distance between the Earth and the Moon

jection, seam, and butt resistance welding, and is used with both synchronous and non-synchronous control. It may be applied to existing welding machines, by suitable modification, as well as to new equipment.

With this new system, it will be possible to operate resistance welding machines at or near unity power factor, thus reducing the kva demand from 50 to 70 per cent, lowering power costs, and minimizing line disturbances and interference between welders and other electric equipment.

In one case, a spot-welder had a demand of 434 kva at 41.5 per cent lagging power factor, when spot-welding two plates each 1/4 inch thick. After the application of this power factor improvement equipment, the same spot-welding machine operated at unity power factor and had a demand of only 181 kva.

First All-Electric Streamline Trains in America

The Chicago, North Shore, and Milwaukee Railroad is placing in operation the first all-electric streamline passenger trains in the United States, for high-speed service between Chicago and Milwaukee. These trains consist of four-car units, weighing approximately 160,000 pounds and having a length of 157 feet. They carry a maximum of 133 passengers at 80 miles an hour. Each train is powered with eight 125-H.P., 300-volt Westinghouse motors. The trains are completely air-conditioned. They will offer speed similar to that of the steam roads between the two cities.

Seamless Rubber-Lined Pipes and Fittings

Rubber-insulated pipe and fittings have been placed on the market by the Paramount Rubber Service, Inc., 1430 Rosedale Court, Detroit, Mich., as a result of eight years of development work. These pipes and fittings are especially intended for the chemical industries, and are completely rubber-insulated inside and out, including flanges and bolt holes. Due to the construction, the flange couplings are flexible, and there can be no "freezing" of bolts in the rubber-lined holes. The rubber is built up in such a manner that there are no seams and laps in the entire construction.



A New Molybdenum-Nickel Electroplating Process

A new black-plating process has been developed by E. I. du Pont de Nemours & Co., Inc. It produces a lustrous deep black electrodeposit. This process, known as the Moly-Black molybdenum-nickel electroplating process, is based on the use of a combination of molybdenum and nickel. The plating process operates at a high rate of deposition at low current densities—twenty times more rapidly than nickel-plating under identical conditions. It produces deposits of uniform thickness, even in deep irregular recesses. Analysis of the deposit shows it to contain 45 per cent of molybdenum and 10 per cent of nickel, the balance being chiefly oxygen.

The coating is applicable to bases of zinc; aluminum; cadmium electroplated on brass, iron, or steel; tin, either electroplated or hot-dipped; nickel; and steel or iron. An unusual characteristic of the process is that it permits plating directly over aluminum prepared only by cleaning in an alkaline bath. The coating is successfully applied over any of the base metals mentioned, particularly as a decorative finish for indoor use. For outdoor use, the plate should be deposited over an under coating of cadmium; the finish coating should be lacquer. Deposits produced by the new process have a maximum thickness of about 0.002 inch.

The plating is applicable especially to electrical accessories; instrument dials; office furniture; lighting fixtures; flashlight cases; automobile hardware and trim; hinges; microscopes, cameras, etc.

EDITORIAL COMMENT

A great task faces the American nation. This task—the Defense Program—at the present stage is chiefly one of engineering and production planning. Fortunately, we have available in these two fields experience and ability of the highest order. The important thing is to take full advantage of this experience and ability. Another essential is speed. To secure this, it is imperative that the usual governmental red tape be reduced to a minimum.

The last war taught us some valuable lessons.

The Lessons of the Last War Need Now be Emphasized

At that time we were slow in making full use of our production facilities because of our lack of experience in handling a vast armament manufacturing program. The difficulties then encountered can today readily be avoided by those having the final authority.

First of all, there must be swift action in placing orders for the machine tools and other manufacturing equipment required to carry out the National Defense Program. Although, at the present writing, it is nearly two months since the President made his appeal to the nation for an increase in aircraft and other necessary war material, and although ample appropriations have now been made available, comparatively few orders have yet been placed by the Government for the machine tool equipment required. It has been said that the machine tool industry is the bottle-neck of our preparedness program; but so far, the industry has not been put to the test by our Government.

Experienced Leaders in Industry Could Speed Production

The great activity in this industry is mainly due to orders from abroad and from private industry. Our own proposed armament program has not yet reached the machine tool industry to any appreciable extent.

The last war taught us that, to achieve results, experienced men must be given full authority. The production program should be placed in the hands of men who, in the past, have solved similar problems, year after year, in arsenals, navy yards, and industry. Mr. Knudsen, in his present capacity, for example, might be empowered to select, without interference, his own assistants from among the Army and Navy officers who have had the most

extensive experience in the design and production of armaments, as well as from among industrial production engineers and shop executives who have proved by their record that they are able to achieve results. The next step would be to let this staff of trained production men procure the manufacturing facilities and machine tool equipment necessary to carry out the production program. If this were done, we might expect results quickly.

Another difficulty that caused much unnecessary delay in the last war was that of complicated and time-wasting designs of war equipment. The designing engineer, whether his work be concerned with war material or industrial equipment, is often inclined to overlook the question of ease and rapidity of production. It is frequently the experienced production engineer who has to suggest modifications in the design that will permit the best and

This is No Time for Personal Preferences or Pet Ideas

fastest production methods to be applied. Sometimes the designer objects to such suggestions because he has in mind some ideal of engineering perfection; or the appearance of a design that can be more efficiently manufactured may not be to his liking; or he may believe that his own ideas are always the best.

At the present moment, however, we are not engaged in achieving either engineering perfection or beauty of design; we are designing for the defense of the ideals of our civilization. The only considerations worthy of attention at this moment are: Can this piece of mechanism be made quickly and efficiently? Will it do what it is expected to do—in war?

Then there is the question of tolerances. In the last war, there were serious delays in production because too close and impracticable tolerances were specified by those responsible for the design. Unfamiliar with manufacturing requirements, they often specified tolerances that were unnecessary for the proper functioning of the equipment, and that reduced output and increased cost to a marked degree. Similarly, inexperienced inspectors insisted on perfection of no value to the purpose of the equipment.

These are some of the lessons of the last war. By avoiding a repetition of the mistakes then made, we shall achieve results.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers
as Typical Examples Applicable in the Construction of
Automatic Machines and Other Devices

Straight-Line Reciprocating Motion for Link-Supported Ram

By J. L. HELMINEN

A horizontal ram located in an atmosphere laden with abrasive material was required to have a straight-line reciprocating motion without being supported by ways or slides. The linkage devised to meet these requirements is shown in the accompanying illustration. Crank *A* and connecting-rod *B* impart the required reciprocating movement to ram *C*. In order to confine the motion to a straight path, four links *D* and two links *E* are utilized. These links are connected to ram *C* at the pivoting points *F* and *G*, the whole linkage mechanism being swiveled at the four stationary bearings *H*. All bearings are sealed to protect them from the abrasive material.

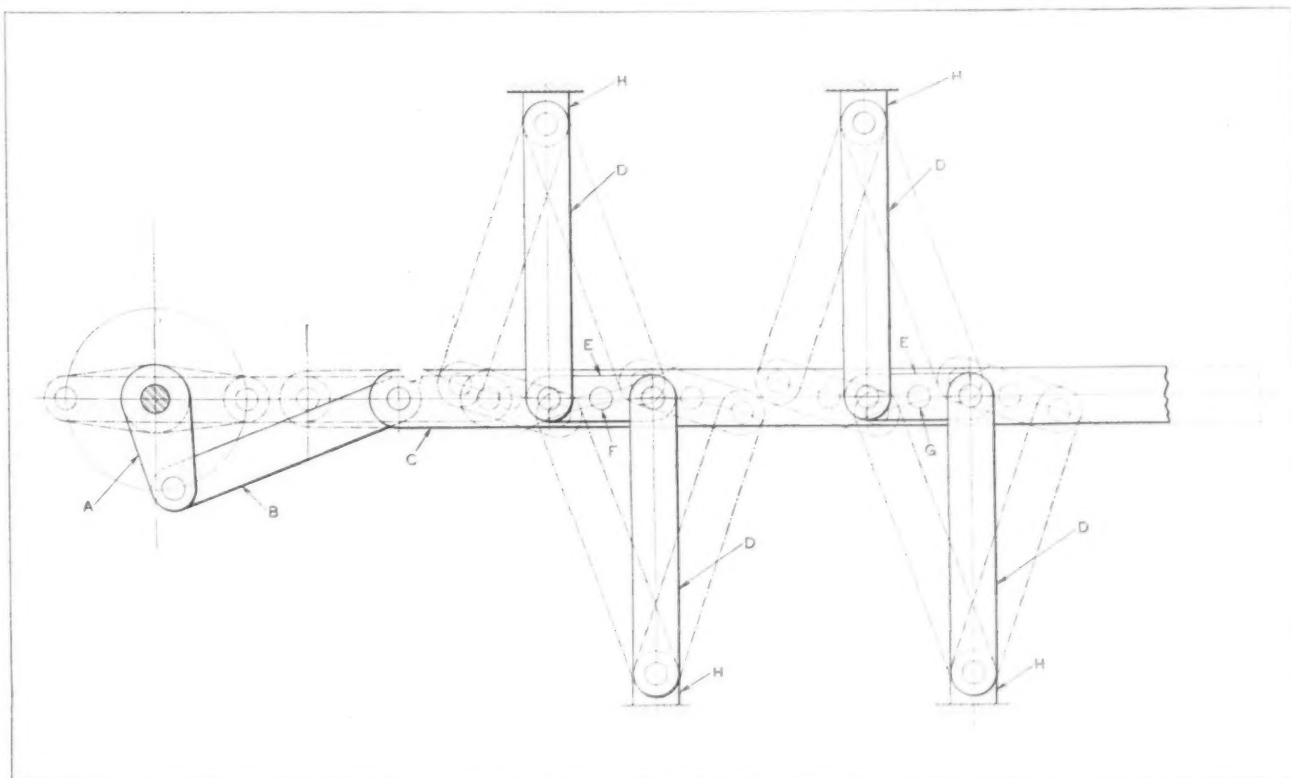
Links *D* and *E* are of such proportions that their centers *F* and *G* move in a straight line; and since the ram is connected at these points, it also moves in a straight path. Links *E* are approxi-

mately 38 per cent as long as links *D*, and the stroke of the ram does not exceed 65 per cent of the length of links *D*. This limitation on the length of the stroke with respect to the length of the links is necessary because points *F* and *G* only move in a straight line within a certain distance, beyond which they begin to move in a curved path.

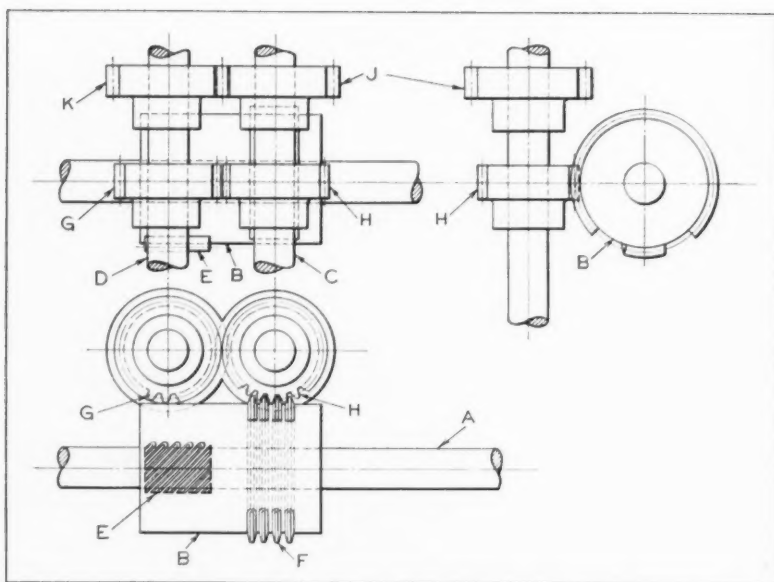
High-Speed Intermittent Gearing

By A. BASSOFF

One difficulty experienced with all types of intermittent gearing, including Geneva movements, is their inability to function properly at high speed. To permit ready engagement and disengagement at relatively high speed, it is necessary to have a certain degree of freedom of motion between the mating parts. This, in turn, causes clashing, incorrect timing, excessive operating noise and wear, and jamming of the mechanism in a short time.



Mechanism for Imparting Straight-line Motion to Ram C



Intermittent Gearing Designed to Operate at High Speed

To overcome these difficulties, designers resort to various expedients, such as spring- or inertia-operated prestarting elements which are intended to lessen the initial shock of engagement. These devices, when properly designed and applied, enable high speeds to be employed, but do not extend the range to the high speed sometimes required.

The accompanying illustration shows an intermittent gear mechanism designed to meet the requirements of nearly noiseless operation at extremely high speed, and positive locking during the rest period. The mechanism consists of driving shaft A which carries a cylinder B, a driven shaft C, and an indexing shaft D. The driven and indexing shafts C and D are at right angles to the drive-shaft A. The cylinder B actually consists of two gears, a spiral gear E and a circular rack F. From each of these two gears certain numbers of teeth are cut away, so that there will be no engagement between the spiral teeth E and the spiral gear G on shaft D when the rack teeth F are engaged with the spur gear H on shaft C. The two shafts D and C are interlocked by gears J and K.

When the gearing is in operation, shaft D is locked in position during the time that circular rack F is engaged with spur gear H. The spiral teeth E engage spiral gear G at the moment when circular rack F becomes disengaged from gear H. While spiral teeth E and gear G are engaged, the shaft D is rotated a predetermined portion of a revolution, as determined by the part of the circumference occupied by teeth E. This movement is transmitted to shaft C through gears K and J.

As the teeth E become disengaged from gear G, the rack teeth F enter gear H and lock shaft C against further

rotation. The accuracy of the mechanism is not affected by the amount of backlash existing between gears E, G, K, and J, because the effective locking action is between F and H. To facilitate engagement, the entering ends of teeth F are pointed, the same as teeth E.

The mechanism described is positive, accurate, and quiet in operation at extremely high speeds. These desirable features are obtained by having all contacts between the driving and the locking members made by sliding surfaces.

* * *

Under Pontiac's New Assembly Line

When the plant engineers of the Pontiac Motor Division of the General Motors Corporation recently installed a new final assembly line, every provision was made for comfortable working conditions in the pits that extend underneath the line. Among the conveniences provided are plenty of head-room, adequate ventilation, and fluorescent lighting, which makes the pit as light as day. These advantages are said to have resulted in a very high quality of workmanship.

* * *

Sometimes one wonders whether the saying of so many of our young people, "There is no opportunity for youth," should not be changed to "There are today few young men able to grasp their opportunities." When a young man of average ability is willing to work, he usually succeeds.

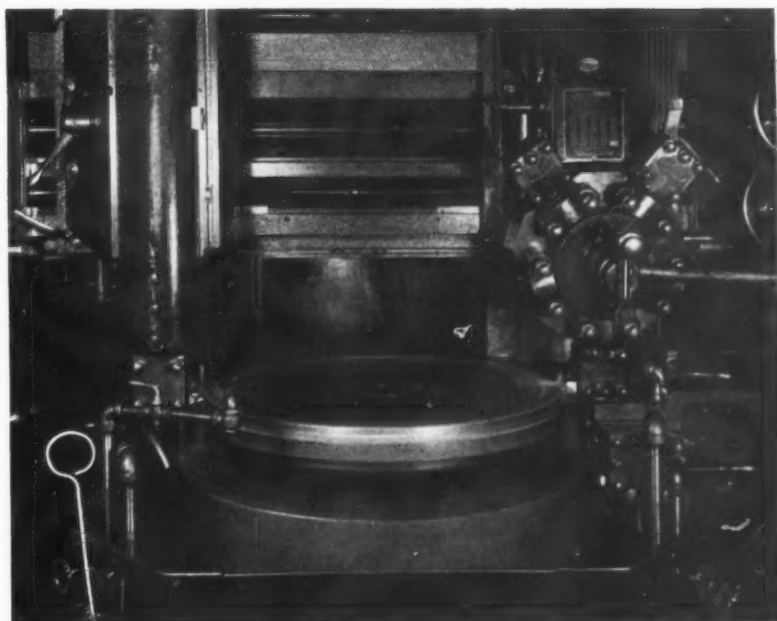


Unusual Working Conditions are Provided in the Pit below Pontiac's Final Assembly Line

The Application of Carbide Tools in a Machine Tool Plant

A Detailed Account of How the Bullard Co. is Effectively Making Use of Cemented-Carbide Tools in the Machining of Work in Comparatively Small Quantities—
First of Two Articles

By BYRON MERWIN
Manager, Standards Department
The Bullard Co.
Bridgeport, Conn.



Turning an S A E 4640 Steel Table-gear with Cemented-carbide Tools at a Surface Speed of 225 Feet per Minute, a Feed of 1/32 Inch per Revolution, and a Depth of Cut Varying from 1/4 to 5/8 Inch

IT is believed by many men responsible for production in the mechanical industries that cemented-carbide tools are not generally applicable in industries where the number of identical parts to be machined is comparatively small. The application of these tools in the automotive industry, for example, is thoroughly understood, and their value appreciated. In a field like that of the machine tool industry, again, where quantities are small, compared with those handled in automotive plants, the new tool materials have not been as readily accepted, particularly not for machining steel parts.

Some time ago, the men responsible for production results in the Bullard plant at Bridgeport, Conn., concluded that cemented-carbide tools could be effectively used for machining steel, cast iron, and non-ferrous metals, even though the number of identical parts produced was comparatively small. The subject was thoroughly studied; and by the application of these tools in a manner suitable to the conditions of manufacture in the Bullard plant, satisfactory results have been obtained. A decided increase in output has been recorded, and a plan worked out whereby, through the application of tools most suitable for each material, maximum efficiency has been obtained.

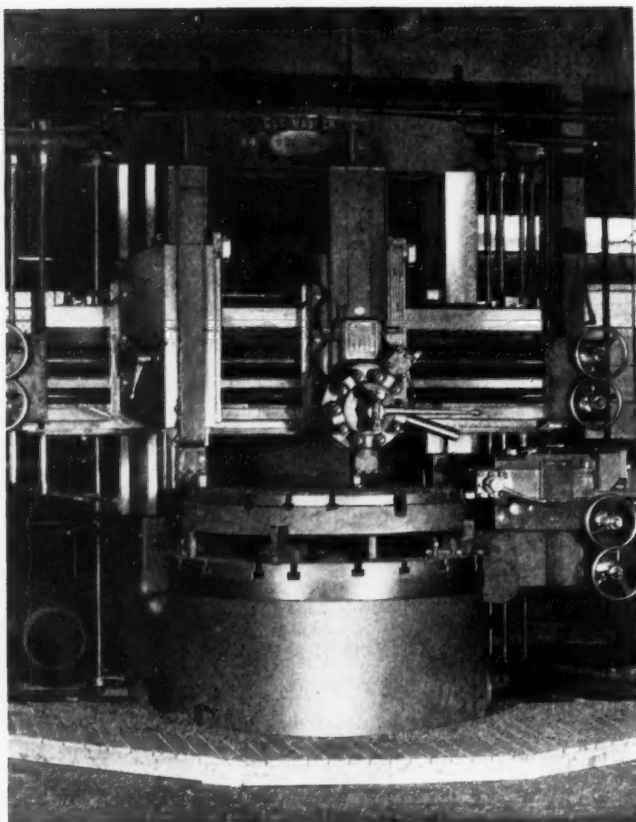
In developing a program for the more general application of carbide tools, particularly in steel turning, it should always be remembered that high-speed steel and Stellite must continue to play an important part in the machining processes. The use of the three cutting materials—carbides, high-

speed steel, and Stellite—must be so coordinated that each is employed where it has proved to give the best results.

Procedure in Applying Cemented-Carbide Tools in a Machine Tool Plant

Until recent years, high-speed steel tools were used exclusively in the Bullard plant for machining the various grades of mild, alloy, and tool steels. Frequent attempts had been made in the machine tool industry to use tungsten-carbide tools for this class of work, and in some cases satisfactory results had been obtained. It was not generally possible, however, to obtain consistent results on all steel-cutting applications for the reason that the carbide grades recommended by the makers were often for specific machining problems, and did not prove satisfactory when applied to other grades of steel.

At first, many of the carbide suppliers were given an opportunity to demonstrate their tools; but from these demonstrations it became evident that there was not a sufficient consistency of performance to justify the establishment of tungsten-carbide tools as an all-inclusive cutting medium. Most of the carbide manufacturers have a large variety of grades, many intended for a restricted



Turning a Cast-iron Table with Tungsten-carbide Tools. Speed, 200 Feet per Minute; Feed 0.040 Inch per Revolution; and Depth of Cut, About 1/2 Inch. Note Cut Interrupted by T-slots in Face

service, but all are likely to be required to cover a broad field of metal-cutting applications.

The varieties of carbide grades have been developed to meet the demands of the mass-production plant, as, for example, in the automotive industry, where the production problems are more or less standardized. Here, each machine generally performs one specific type of operation; the amount of material to be removed is, as a rule, uniform; and the machinability of the metal being cut is definitely controlled. All these factors lend themselves to a careful selection of a specific grade of carbide for each application.

It is obvious that, in a machine tool plant, it would be impossible to select one grade of carbide for each application, because the large variety of grades necessary would be too costly, as well as impracticable from the operating point of view. It was, therefore, concluded that if economies were to be obtained from the use of carbide tools in a plant of this description, it would be necessary to standardize on as few grades as possible, sacrificing, perhaps, the maximum results in some instances, but making it possible to use a grade that would be adaptable to all classes of steel turning. It was believed that, in this way, the level of production could be raised without complicating the problem of tool control, particularly from the operator's point of view.

These conditions were presented to the makers of cemented carbides, and, as a result, one carbide manufacturer recommended a grade that, it was believed, would perform satisfactorily on all classes of steel turning. This grade was tried as a general-purpose tool. It soon became evident that, in order to attain success, much had to be done to impart to the machine operators the technique required in the use of the carbide tools.

The cemented-carbide manufacturer offered to the Bullard Co. the services of a field engineer, suggesting that he spend considerable time in the plant instructing the operators in the technique of using the tools. These services were accepted and a broad program of education established.

A tool supervisor was appointed to specialize on this problem, cooperating with the field engineer. As a result, it has been found practicable to select a few grades of carbides that cover practically all machining requirements for all the metals used in the construction of the machine tools built by the company. To do this, however, it was necessary to make a careful study of all the elements involved, including the machines upon which the operations were performed, the horsepower requirements, and the design of the tools themselves.

It was established through tests that carbide tools for cutting steel perform most satisfactorily at surface speeds of from 225 to 300 feet per minute. When the surface speeds are much lower than 200 feet per minute, the efficiency of the carbide tools is not satisfactory.

Having established certain speeds at which the carbide tools would operate most efficiently, many experiments were undertaken to determine the cutting angles, clearances, etc., that would produce the most satisfactory results. In this connection, the assistance of H. S. Wilcox, equipment engineer of the Worthington Pump & Machinery Corporation, proved very valuable. Mr. Wilcox had made extensive tests to determine the best cutting angles, requiring the least horsepower consumption, and he made the results of these tests available to the writer. These data, therefore, were used as the basis for establishing standard angles by the Bullard Co. for all steel turning tools.

Fabrication and Standardization of Carbide Tools

Our company is now fabricating its own tools. The shanks, in most instances, are castings made from a pattern of the correct shape. These shanks require a minimum of machining, except the milling of the cavity for the tip, which is brazed and ground in the cutter grinding department. The tools are hand-ground on an Ex-Cell-O tool grinder having a tilting table and angular parallels which may be set to the correct position for grinding the tools. The grinding operator takes care not to over-heat the carbide, thereby causing fractures. The grinding operation is highly important, and must be handled by men who are experts in that work.

The material used in the tool shanks is a nickel-chromium-molybdenum cast iron which has a high degree of resistance to deformation under the tip, as well as high heat conductivity and a low coefficient of expansion. Since adopting this shank material as a standard, the breakage of carbides that formerly occurred when steel shanks were used has been largely eliminated. The shapes and sizes of the tools and shanks have been standardized, and all styles are carried in the tool-crib, where they are available for all types of operations.

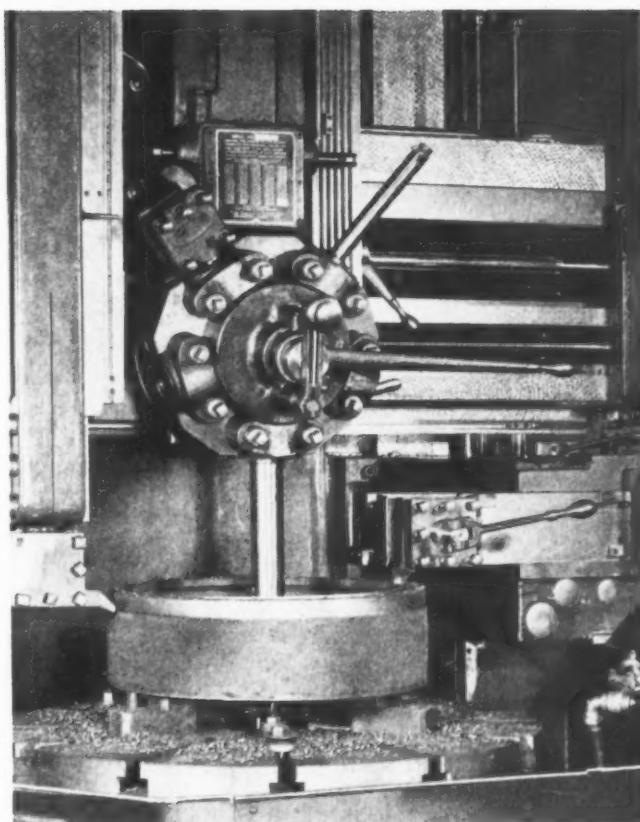
Precautions in the Use of Carbide Tools

As has often been stated, in using carbide tools, it is imperative that they be rigidly clamped and supported as close to the cutting edge as possible. Belts for the machine must be tightened, clutches adjusted, and the machines kept in first-class working condition, with sufficient power to obtain maximum results. Sometimes it may be necessary to apply a larger motor, in view of the fact that these tools produce the best results when the machine is operated at a surface speed of approximately 250 feet per minute.

The importance of the power requirement was particularly noticeable when the carbide tools were used on a Bullard "Cut Master" vertical turret lathe, which has a high horsepower rating and a geometrical progression of speeds and feeds, permitting the frequent selection of speeds to obtain the best results from the carbide tools. These machines, with multiple tooling, made it possible to remove an amount of material that would not have been practicable with former types of tools.

Instruction of Operators

It became necessary to instruct the operators in the technique of the use of carbide tools, since this technique is different from that used for high-speed steel tools. The carbide tools are much harder, and care must be taken to avoid excessive tool breakage. The surface speeds are approximately three times as high as are used with high-speed steel. There are certain other essentials that require constant checking in order to obtain the best results. The operators were instructed to return the tools to the tool-crib for replacement as soon as they began to show the slightest wear on the cutting edge. The cutter grinding department is adjacent to the tool-crib, and here competent men are engaged in resharpening the tools to keep the entire supply in first-class condition. Specific examples will be given, in a coming installment of this article, showing how carbide tools are being applied. In standardizing on as few grades of carbides as possible, the Bullard Co. finally adopted Carboloy 78B and McKenna KM for all steel turning operations, and Carboloy 44A for cast iron and non-ferrous metals. These grades are used exclusively as general-purpose tools for all operations where carbides can be used to advan-



Turning a Cast-iron Pulley at a Surface Speed of 300 Feet per Minute, a Feed of 1/16 Inch per Revolution, and a Depth of Cut of 3/8 Inch

tage. Obviously, if other carbides should be developed that excel these grades in all-around performance, such new grades would be adopted; but under any circumstances, it would be inadvisable to make use of a larger number of standard grades than those adopted.

* * *

Taxing the Railroads into Bankruptcy

For every dollar of net income earned by the railways in the nine years ending with 1939, taxes amounted to \$12.38, according to the *Railway Age*. During this period, taxes averaged more than \$295,000,000 annually, while the net income of the railroads averaged less than \$24,000,000. In striking contrast are the figures for the years 1921-1929. In that period, taxes amounted to only 56 cents for every dollar of net income earned.

With such an enormous increase in taxes in proportion to net income, is it any wonder that so many railroads have already passed into bankruptcy? The prospects for the well-being of the people in the United States are not very bright if our various governments—federal, state, and municipal—cannot adjust their spending of tax money in some degree to the taxpayers earning capacity. As a matter of fact, the less industry has been earning, the more government has been spending.

Ford Operates the World's Largest

THE 1200 acres within the confines of the River Rouge plant of the Ford Motor Co. at Dearborn, Mich., have been appropriately termed "the most productive land in the world"—land that would have comparatively little value except for the enterprising spirit of Henry Ford and his associates. No project appears too great to that organization if it will result in a product of higher quality or effect substantial production economies.

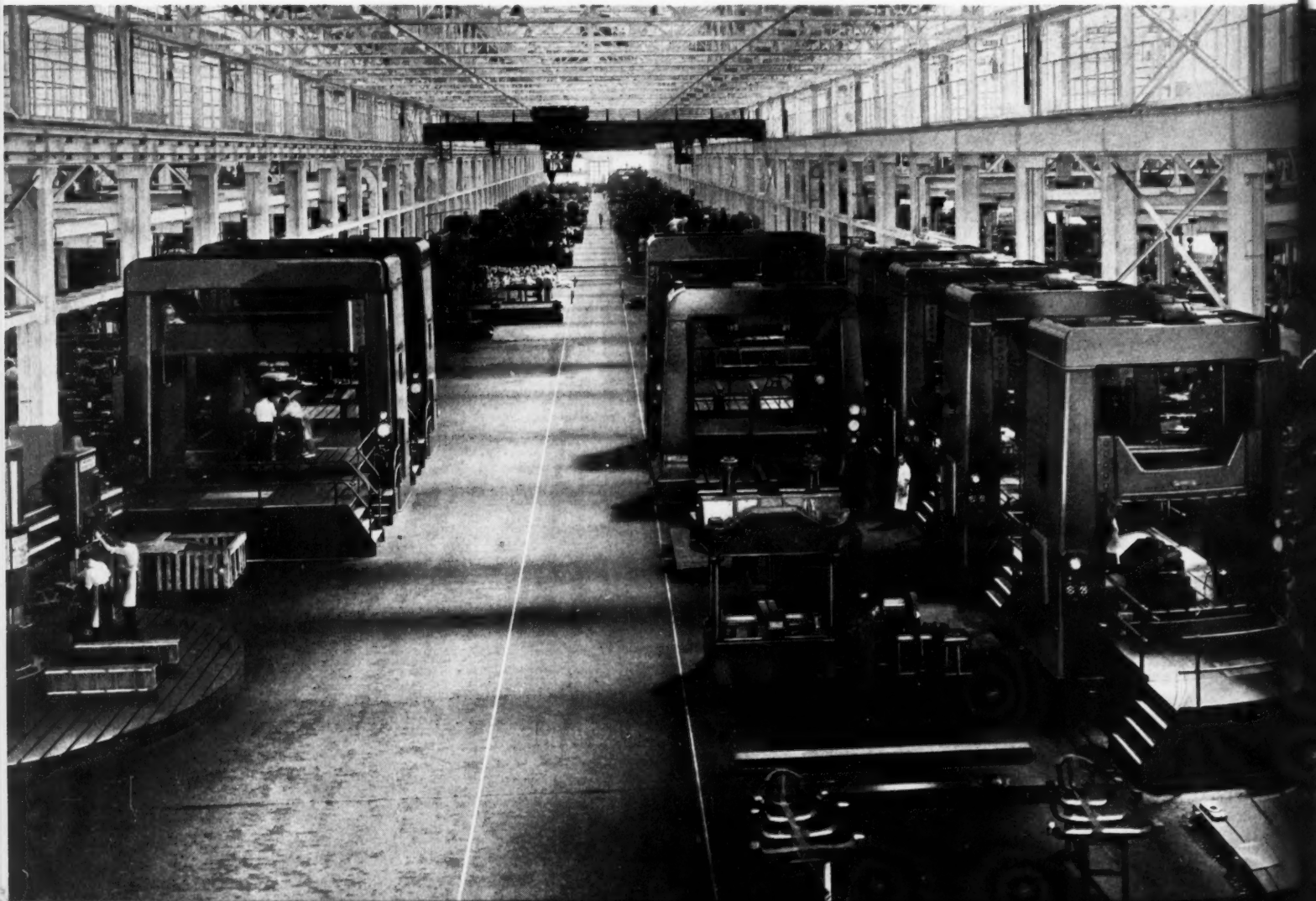
One of the most recent additions to this already huge industrial plant is the world's largest tool and die shop located under one roof. This shop is housed in a building 1200 feet long by 300 feet wide, which has more the appearance of an educational institution than a factory for producing tools that cut and form metal.

The building is one of the most modern in the world. Glass windows extend practically around the complete structure, making daylight available everywhere, as will be apparent from the illustration below, which shows a view looking down the central bay of the building. Natural lighting is

supplemented on dark days by the latest kind of artificial lighting. Air-conditioning insures cool, clean working conditions during the summer, and heated, clean air throughout the winter months. This building houses more than \$3,000,000 worth of machine tools and employs approximately three thousand men at the present time. Some of the outstanding machines are shown in this article.

On both sides of the central bay at one end are huge spotting presses, as seen in the illustration on this page, which are used in matching the male and female members of large body dies. A typical operation of this kind is shown in Fig. 1. The bottom die member is placed on the table of the machine but not bolted in place, being left free to position itself slight amounts when the punching member attached to the ram of the press is lowered into place. The surfaces of the female die with which the punch comes in contact are coated with Prussian blue, so that high spots can readily be detected when the punch is seated, and then chipped or ground off with high-frequency portable electric tools.

Looking up the Main 1200-foot Long Aisle of the Ford Tool and Die Shop, Large Spotting Presses being Seen in the Foreground



Tool and Die Shop

One of the outstanding features of these spotting presses, of which there are eight, is the provision for convenient loading of the heavy dies. The table is so arranged that it can be raised a slight amount by hydraulic pressure from the series of flat ways on which it is normally supported. It can then be rolled on tracks to the front of the uprights, so that the dies can be lowered on the table through the use of a 50-ton overhead crane. The table is then rolled back into the position seen in Fig. 1 (which shows a view from the rear of the press), and is again lowered on the flat ways prior to the matching of a die set.

Another feature of these spotting presses is the large micrometer adjustment by means of which the position of the upper platen or ram with reference to the top of the table can be controlled within 0.005 inch. The ram is also operated hydraulically. The dies handled in these spotting presses range up to 12 tons in weight.

Sheet-metal dies are machined to their required contours and dimensions by automatic tool-room engraving machines of the type seen in Fig. 2.

There are sixteen of these machines of various sizes in the tool and die shop, the machine illustrated being one of the largest. The tool-head of this machine has a vertical feed of 6 feet, a horizontal feed of 12 feet, and a spindle travel of 30 inches. This range adapts the machine for handling dies from the smallest to the largest that go through the shop. In Fig. 3 is shown a close-up view of a typical operation performed on one of these machines.

A large boring, drilling, and milling machine of the table type, which is employed for a variety of work, is shown in Fig. 4 performing a typical face milling operation. The table of this machine measures 8 by 16 feet, and the cutter-spindle can be raised to a point about 10 feet above the top of the table.

In Fig. 5 is shown one of several modern radial drilling machines, which is provided with a semi-circular table base large enough to enable the set-up of several jobs while the machine is in actual use on other work. This machine has a swing of 8 feet.

General View of the Heat-treating Department, in which a Comfortable Working Temperature and Clean Atmosphere Prevail at All Times



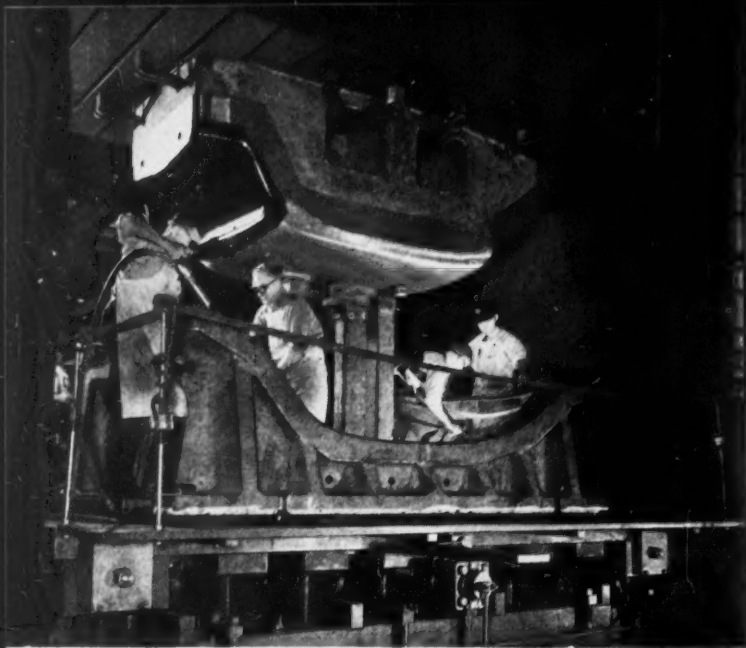


Fig. 1. Matching a Female Body Die to the Punch in One of the Eight Large Spotting Presses Installed in the New Ford Tool and Die Shop

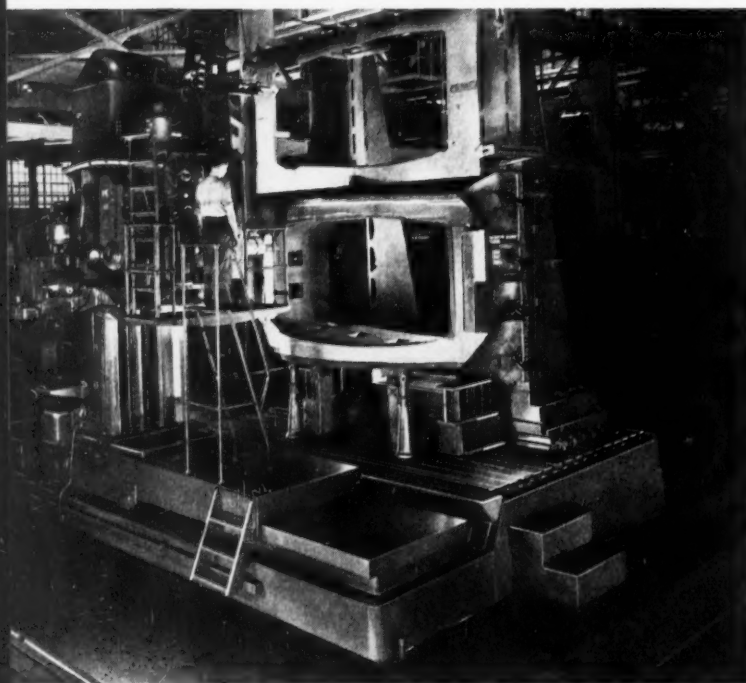


Fig. 2. (Above) Automatic Tool-room Engraving Machine which Handles the Largest Body Dies. Fig. 3. (Below) Milling Operation on Machine Shown in Fig. 2



A large boring mill employed in a section of the shop devoted to the maintenance and building of special machinery is illustrated in Fig. 6. The table of this machine is 16 feet in diameter. Another interesting machine tool in the same section of the shop is the big lathe shown in Fig. 7, which has a swing of 14 feet and will accommodate work up to 34 feet long between centers. The job shown in this lathe consisted of truing up a 57-ton generator rotor used in the main power house of the plant. This job was accomplished in 4 1/2 hours, whereas weeks of delay would have occurred had it been necessary to ship the rotor to the plant where the generator was manufactured.

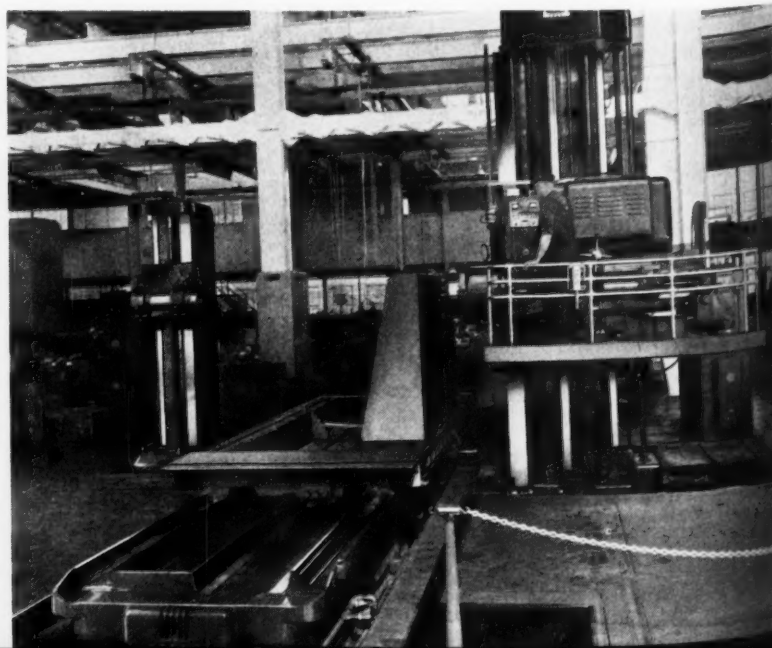
The surface grinding machine shown in Fig. 8 is used extensively for grinding large sections of boiler plate used for die sets. This machine is equipped with a magnetic chuck 5 feet in diameter, surrounded by a non-magnetic ring 1 foot wide, which provides a total diameter of 7 feet. Pieces up to 50 inches in length by 30 inches in width are ground within customary limits of 0.002 inch.

There are machines for cutting gears from 3/4 inch to over 6 feet in diameter, and there is a department fitted out with the latest types of welding equipment. Hoists are provided over all benches to facilitate work-handling, and there are cranes ranging from 5 to 50 tons in capacity.

The tool and die shop is also provided with its own heat-treating department, which is a model from the standpoint of cleanliness and comfort. Sheet-metal partitions, made of Wellsville metal and trimmed with chromium strip, enclose the furnaces, as seen in the illustration on page 109. These partitions provide an unusually neat installation, and enable the air-conditioning system to maintain a comfortable temperature where the men are at work. Openings in the partitions provide access to the furnace doors. At these openings blasts of cool air are directed up from the floor to prevent the

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Fig. 4. Face Milling Operation being Performed on a Machine that Can Also be Applied to the Boring and Drilling of Large Die and Machine Castings



heat of the furnace from passing into the room proper. Although the furnaces are operated at temperatures up to 2400 degrees F., the areas in front of the furnace openings are always comfortable. Even behind the partitions, the temperature is never uncomfortable. Approximately 65,000 cubic feet of cool air is blown through this heat-treating department per minute.

* * *

Sound Slide Film Available to Prevent Industrial Eye Accidents

How eye accidents may be prevented in industry through the education of workmen and the use of goggles and other protective equipment is portrayed in a new slide film "The Eyes Have It," sponsored by the National Society for the Prevention of Blindness. Combining humor with a serious presentation of the subject, this educational film is intended for groups of workmen, foremen, and safety directors. Inquiries concerning the showing of the film in industrial plants should be addressed to the Society at its headquarters, 50 W. 50th St., New York City.

* * *

General Electric Notes Marked Upturn in Business

Orders received by the General Electric Co. during the three months ended June 30 amounted to \$115,000,000, compared with about \$82,000,000 in the same period last year, an increase of approximately 40 per cent. For the first six months of this year, the orders received amounted to over \$212,500,000, compared with \$169,000,000 in the same period a year ago, an increase of 26 per cent.

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Fig. 7. A Lathe in the Machine Repair Department of the Shop which Swings Work up to 14 Feet in Diameter and up to 34 Feet in Length between Centers

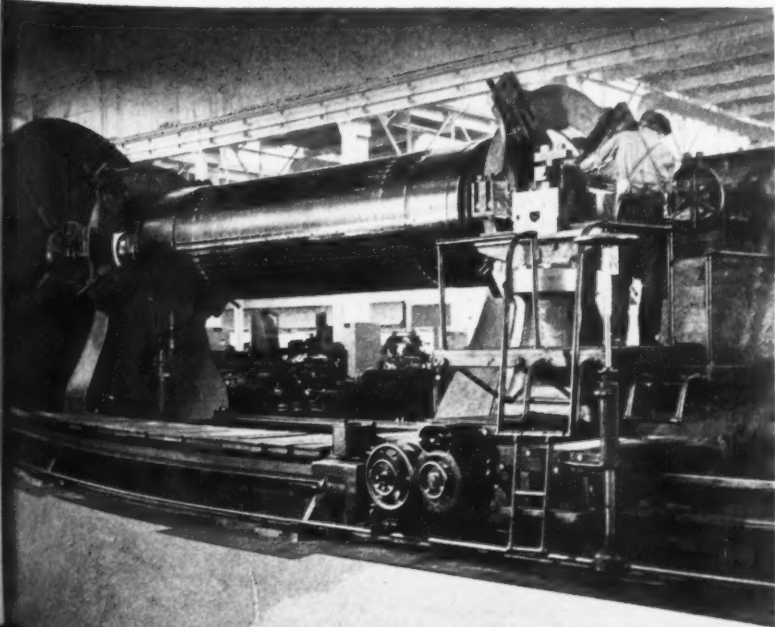


Fig. 5. (Above) Radial Drilling Machine with Large Semicircular Table. Fig. 6. (Below) Large Boring Mill Used in Repairing and Building Machinery

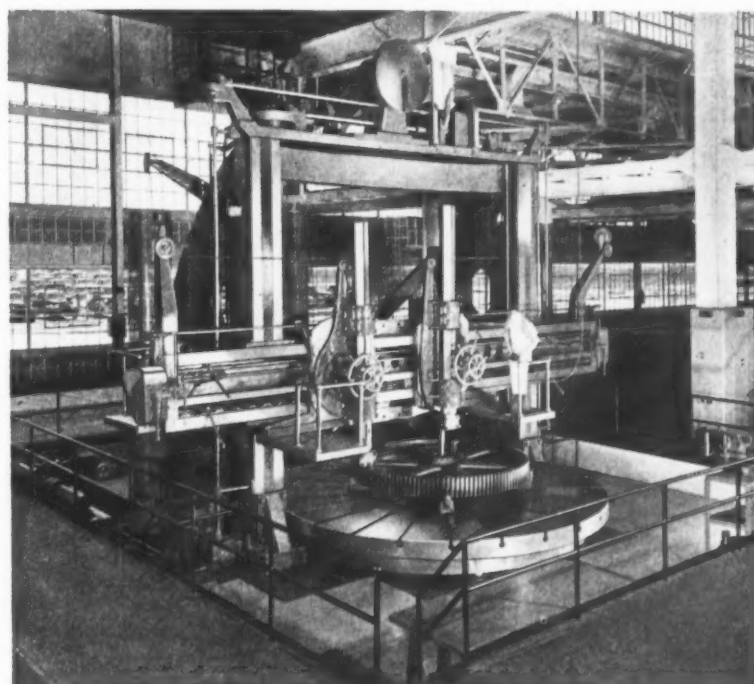
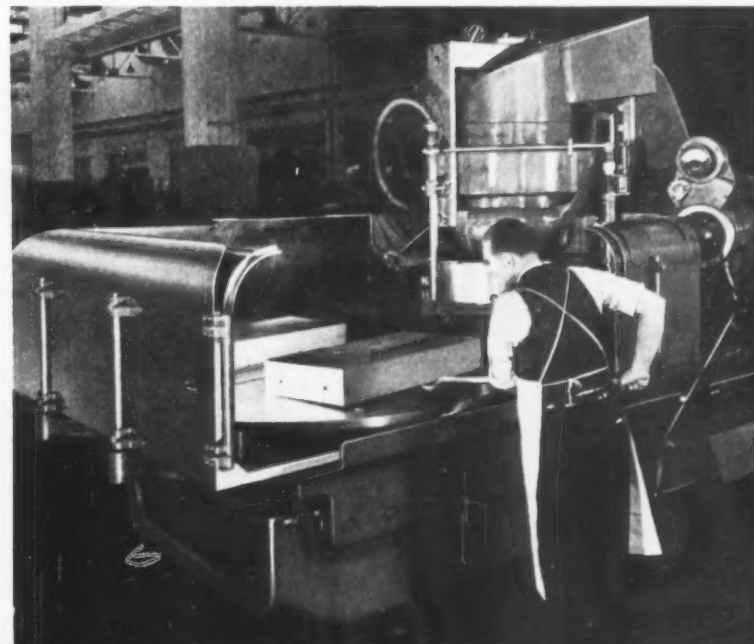


Fig. 8. (Below) Grinding Large Sections of Boiler Plate for Use as Die Sets on a Surface Grinding Machine Equipped with a Table 7 Feet in Diameter

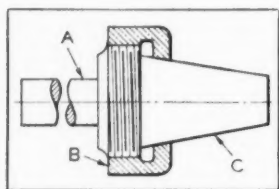


Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work

Holder for Special Buffing and Polishing Tips

The accompanying illustration shows a handy tool for use in buffing and polishing surfaces that require tips of special shape made from cork, rubber, or wood. Tips of this kind, when mounted in the holder, provide means for finishing work that would be difficult to handle in any other manner. The shank of holder *A* fits into the lathe or drill chuck, and the tip *C*, selected for the particular work to be polished, is clamped firmly in position by the nut *B*.



Holder for Special Polishing Tip C

Toronto, Canada

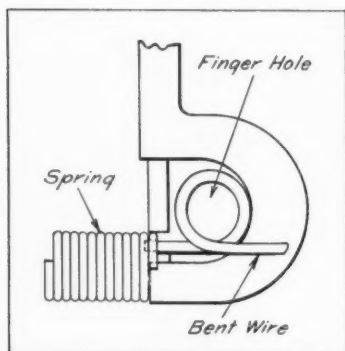
JAMES H. RODGERS

Micrometer Attachment for Measuring Coil Springs

Often it is necessary to measure the diameter of the wire in a coil spring. It is difficult to do this with a micrometer, because every part of the spring presents a bent surface. However, the required measurement can be taken with a micrometer by using a simple attachment made from a piece of wire.

The wire is simply bent, as indicated in the illustration, so that it rests on the lower anvil of the micrometer when measuring the diameter of the wire in the end coil of the spring. The attachment is held in position by simply placing the finger in the loop formed by the wire. In measuring, it is necessary, of course, to allow for the thickness of the wire.

The attachment can also be employed for measuring other cylindrical or bent surfaces, as, for instance, the wall thickness of a tube or pipe.

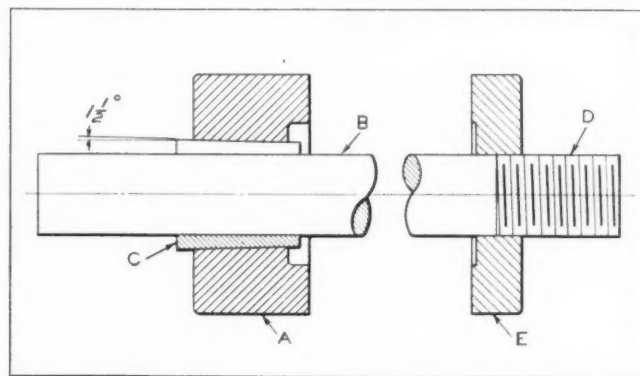


Method of Measuring Wire Diameter of Coil Spring

H. MOORE
Leeds, England

Mandrel Thrust Collar Designed for Lengthwise Adjustment

The accompanying illustration shows a tight collar at *A* that can be adjusted lengthwise on mandrel *B* to accommodate pieces of various lengths clamped against it by means of a nut on the threaded end *D* of the mandrel. The collar is locked in place by a split taper sleeve *C*. This taper sleeve can be easily loosened or tightened by using a piece of tubing that will fit loosely over the mandrel and



Taper Sleeve Arrangement for Securing Collar to Mandrel

can be struck with a hammer as required. The provision of loose collar *E* and sufficient thread for the nut at *D* makes accurate location of the tight collar unnecessary.

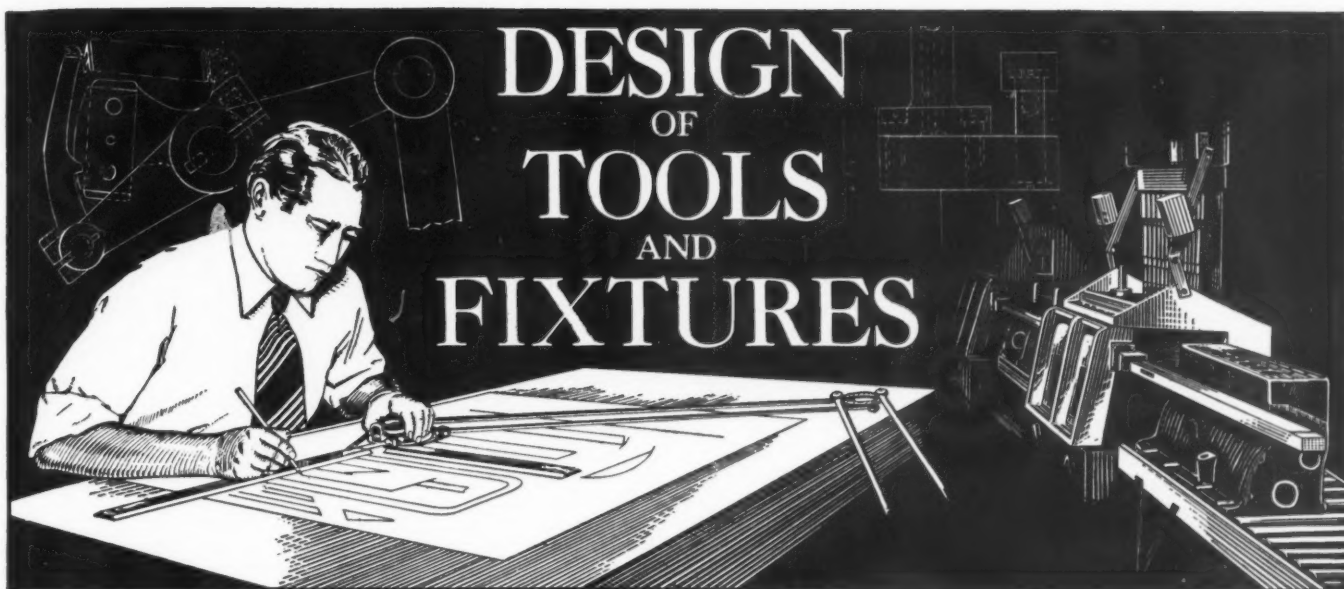
Tight and loose collars of the design described can be applied to mandrels of various lengths, but of the same diameter, thus reducing the amount of mandrel equipment required.

E. WATERMAN

* * *

Where Stainless Steel Saved in Manufacturing Costs

An instrument manufacturer found it necessary to use steel screws in order to get the required strength, and as corrosion resistance was also essential, the screws had to be plated. The accuracy required in the screws was such that they had to be machined slightly under size to allow for the thickness of the plating. This meant two sets of gages and two separate inspections. It was found cheaper to make the screws from stainless steel, since this eliminated the plating and the additional inspection.



Three-Stage Piercing and Forming Die

By GEORGE WILSON, Mankato, Minn.

One complete piece, such as shown at *A* in the illustration, is produced at each stroke of the press from soft steel, 0.012 inch thick. A diagrammatic plan view of the die used for the production of this piece is shown in the upper view, the stripper plate having been omitted for clearness. The stock *B* is about 1/16 inch wider than the length of the piece produced. The original edge of the stock forms the bottom or wide end of the piece.

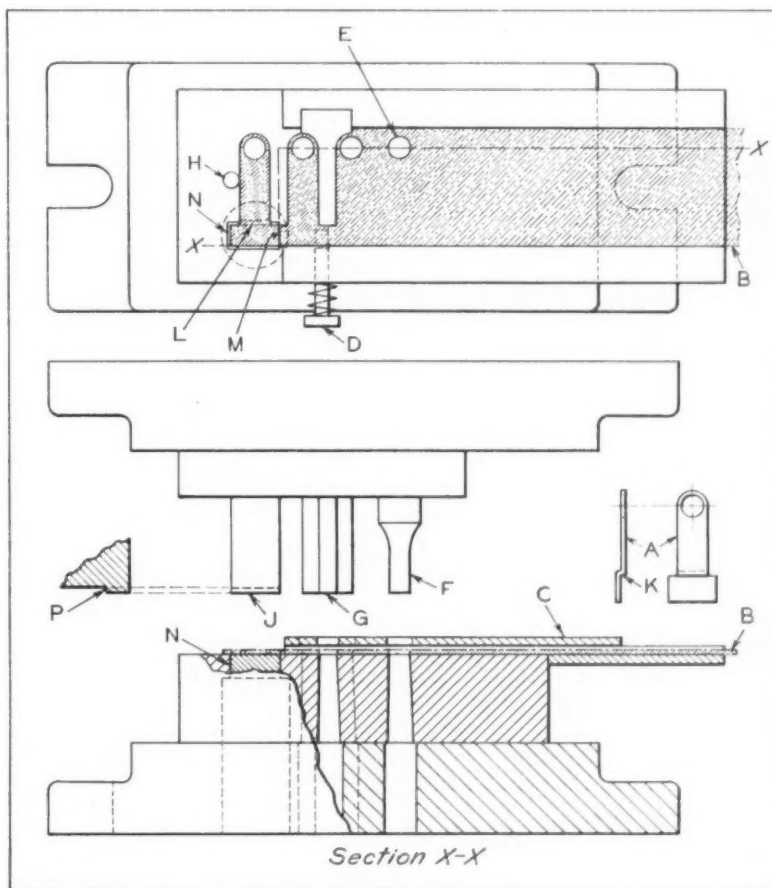
After stock *B* has been started under the stripper plate *C*, temporary stop *D* is held in to locate the end of the stock for punching the hole at *E* with punch *F* on the first stroke. At the same time, punch *G* shears the end of the stock to form half the contour of a finished piece. Stop *D* is then allowed to spring back, and the stock is moved

to the second position, where punch *G* shears the other side of the first piece and half the next piece.

In the next position, the stock is located against the fixed stop *H*. The combined forming and shearing punch *J* now forms the bend in the piece over the edge of the hole in the die at *L*, and also shears the finished piece off against the side of the hole at *M*. Spring pad *N* is fitted in the rectangular hole in the die. The base of pad *N* consists of a cylindrical member

which slides in a hole bored in the die-shoe, the upper end only being shaped to fit the rectangular hole in the die. A stiff spring holds the pad against the stock. Shoulders on the pad *N* locate its upper surface flush with the face of the die.

All the punches contact with the stock at about the same time. Punch *J* shears the finished piece off while punches *F* and *G* are piercing and shearing. The spring pad holds the loose piece against punch *J* as the punches continue downward until shoulder *P* on punch *J* forms the bend *K*.



Three-stage Die for Piercing, Forming, and Blanking Piece *A*

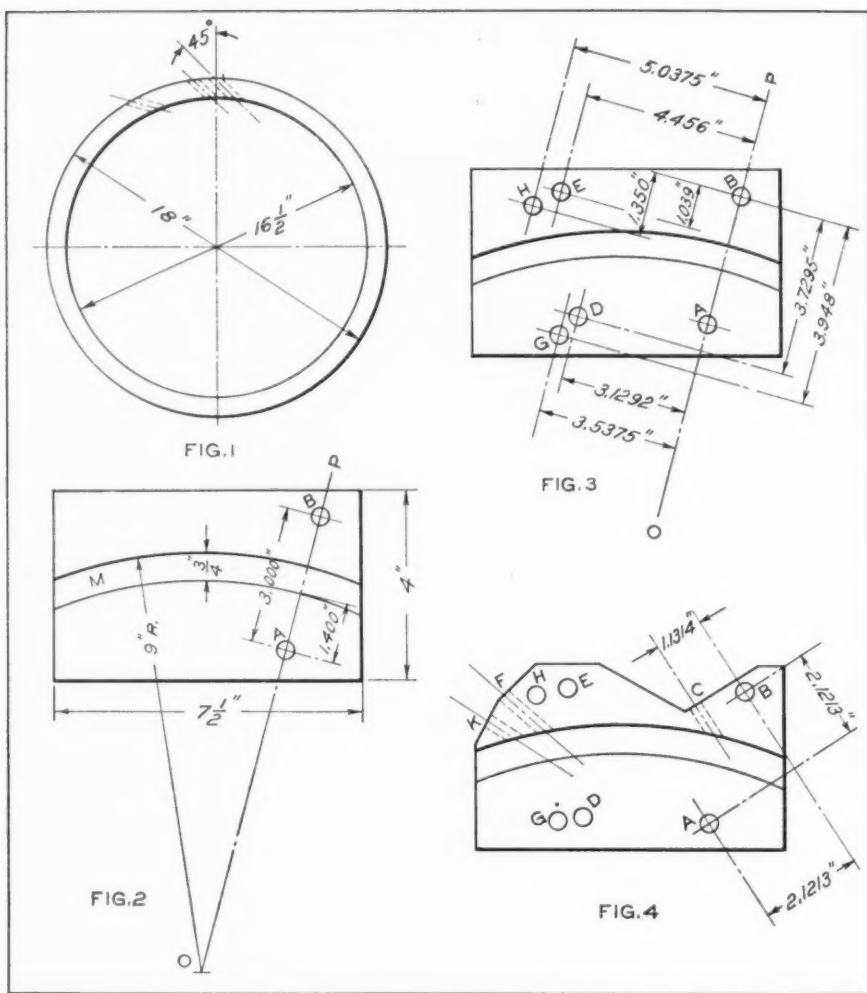


Fig. 1. Ring in which Ninety-six Evenly Spaced Holes are to be Drilled
Fig. 2. First Step in Making Simple Drill Jig. Fig. 3. Lay-out of Holes
Used in Locating Holes K, F, and C in Completed Jig (See Fig. 4)

Jig for Drilling Ninety-Six Evenly Spaced Angular Holes in Ring

By H. KAFFINE, Philadelphia, Pa.

The drilling of ninety-six evenly spaced holes around the circumference of the ring shown in Fig. 1 presented quite a problem. The size of the ring and the fact that the holes were required to be drilled at a 45-degree angle made it impossible to handle the job on the dividing head. It was therefore necessary to make a special jig. The jig was required to have a bushing for guiding the drill and a second hole for a locating pin. It was obvious that, if the two holes for drilling and locating the holes were adjacent, any error in their spacing would accumulate ninety-six times. In other words, if the error were only plus or minus 0.003 inch, the last hole drilled would be almost 5/16 inch out. This would, of course, mean that the work would have to be scrapped.

In order to avoid this condition, the hole *F* for the locating pin, shown in the finished jig, Fig. 4, was drilled at an angle of 30 degrees from the drill hole *C*. With this lay-out, the jig could be used

for drilling every eighth hole. Thus, any error in the spacing of the holes would be accumulated only twelve times. A second locating hole *K* was drilled 3 3/4 degrees from hole *F*, this spacing being equivalent to one ninety-sixth of the complete 360-degree circle.

After all twelve holes of the first series were drilled, the locating pin was moved from hole *F* to hole *K*, so that the thirteenth hole drilled through the guide hole *C* was adjacent to the first one. After the thirteenth hole was drilled, the locating pin was again moved to hole *F*. All the holes from the fourteenth to the twenty-fourth hole were then drilled the same way as the holes from the first to the twelfth, thereby completing the second series. The succeeding holes were then drilled in the same manner. This method of spacing resulted in the production of a fairly accurate job.

The jig itself was of simple design, being simply a block 3/4 by 4 by 7 1/2 inches, as shown in Fig. 2. In making the jig, a groove *M* was first machined to fit the ring. This groove was cut into the block. Before the block was removed from the machine, radial line *OP* was scratched on its surface.

Next the block was set up on the milling machine with line *OP* in a horizontal position for drilling the working holes *A* and *B*, the positions of which were selected arbitrarily. After drilling these holes, the working holes shown in Fig. 3 at *D*, *E*, *G*, and *H* were drilled. The angular distance between holes *AB* and *DE* is 30 degrees, and the distance between *DE* and *GH* 3 3/4 degrees, but for the sake of simplicity, the dimensions were all converted into straight decimal figures, as shown. Finally, holes *C*, *F*, and *K*, Fig. 4, were drilled at 45 degrees to the axis or center of the radial lines passing through the pairs of lay-out holes. Again, in order to facilitate the machine work on the jig, the angular dimensions were converted into straight decimal dimensions.

When the jig was set up for production, hole *C* was brought into line with the spindle of the machine. The jig was then permanently clamped to the machine bed. A plain clamp (not shown) was provided for clamping the ring down in the groove. This clamp was loosened after each drilling operation, so that the ring could be moved far enough to permit the locating pin to engage the hole that had just been drilled.

Boring Fixture Designed to Accommodate Three Different Parts

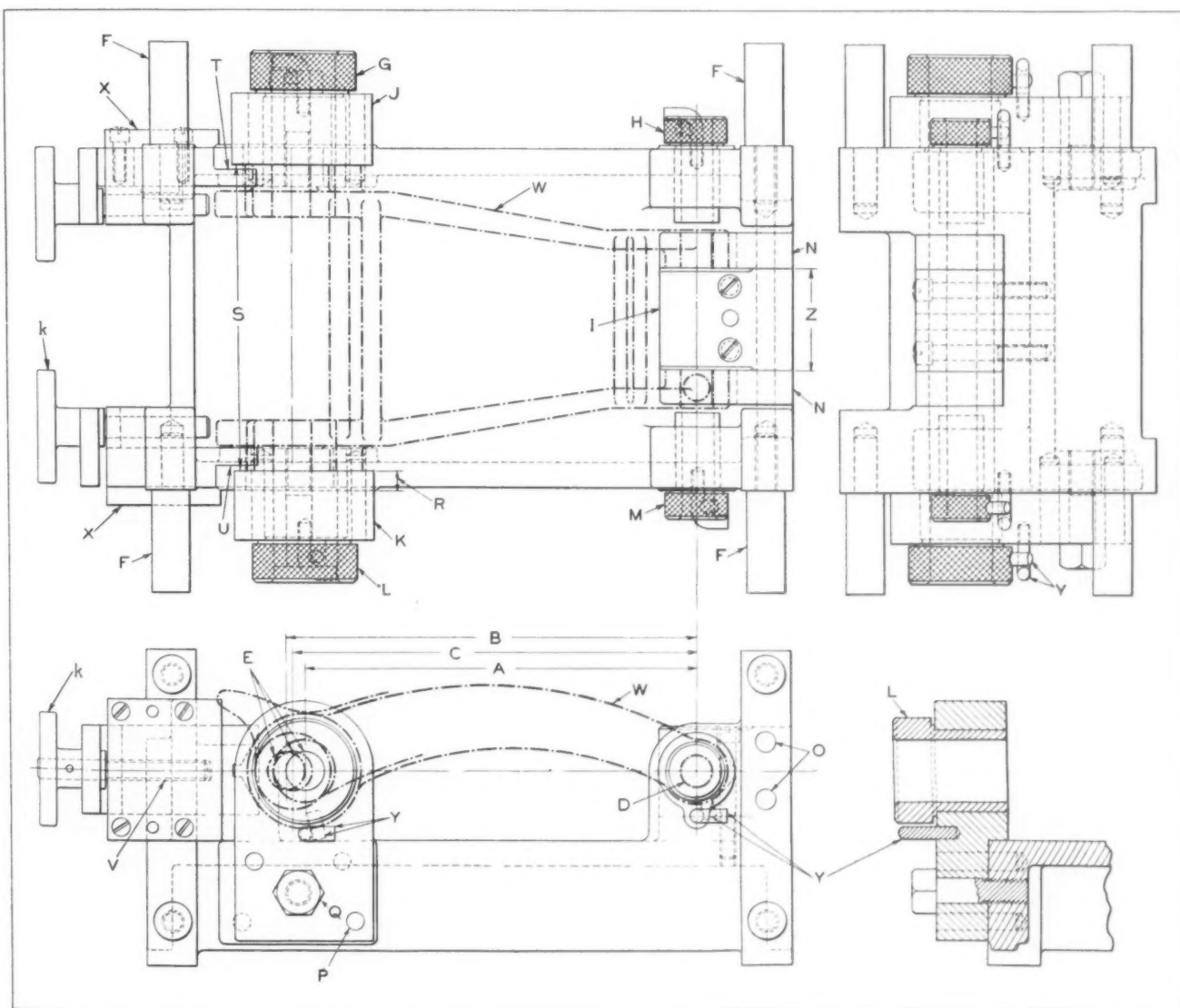
By F. SERVER

As a measure of economy, the box type fixture here illustrated was designed to accommodate three different lever arms. Each of the three arms, one of which is shown by the dot-and-dash lines at *W*, is bored and reamed to give a different center-to-center distance between hole *D* and the hole at the opposite end.

The dimensions indicated by reference letters *A*, *B*, and *C* represent the center distances between the holes in the three different lever arms. Three arrows leading from reference letter *E* indicate the positions of the holes in the different arms. The bushing for hole *D* at the right-hand end of the fixture is permanently located, while the bushings used at the left-hand end are contained in removable blocks to permit varying the center distances as indicated by dimensions *A*, *B*, and *C*.

Work *W* is supported in the cast-iron fixture as shown, four extension posts *F* being provided at each side to act as feet for the fixture when it is turned over, the boring and reaming being done from both sides through bushings *G* and *H* at the rear and bushings *L* and *M* at the front of the fixture. Mounted in the center of the fixture is a block *I* of width *Z* over which the finished bosses of the work are fitted to provide sidewise location, while two V-blocks *N*, held in place by two rods *O*, center the bosses. Rods *O* pass completely through the body of the fixture.

Referring to the construction of the left-hand end of the fixture, blocks *J* and *K* are used to hold bushings *G* and *L*. These blocks are located on the side of the fixture by means of two dowels *P* and held in place by screws *Q*, there being one at each side of the fixture. The blocks that hold the bushings have a step machined in their sides to a depth *R*, so that the distance *S* between the ends of the bosses is correct for locating the work. With the work in the position shown, a pair of V-clamps *T*



Boring Fixture Designed to Handle Work Having Three Different Center Distances *A*, *B*, and *C* between the Holes to be Bored and Reamed

and *U* are forced against the bosses at both sides of the work. The V-clamps are used to center the work, as well as to hold it securely in the fixture.

In constructing the V-clamps, it was necessary to offset clamping screws *V* relative to the centering vee. Knobs *k* pinned to screws *V* are used to tighten the clamps. Two plates *X* hold the V-clamps slidably in place in the body of the fixture. The two blocks *J* and *K* are used for only one center distance—namely, that indicated as *A*. Whenever work with a center dimension *B* or *C* is to be handled, these blocks are replaced with ones of the correct dimensions, equipped with suitable bushings. The slip bushings at all four holes are prevented from turning by the pairs of pins *Y*. A set of plain drilling and reaming slip bushings is provided for the small hole at *D*. An extra bushing for a boring tool is furnished for the large hole at the opposite end of the work.

Lathe Attachment for Machining Spherical Seats of Special Valves

By STANLEY PORRITT, Philadelphia, Pa.

In building a food-processing machine, it was necessary to provide a rotating port valve that would be steam- and vacuum-tight, impervious to corrosive juices from the food products, and non-rusting when the machine was shut down between seasons. To meet these requirements, the stationary half of the valve shown at *A*, Fig. 1, was made of bronze, while the revolving half shown at *B* was made of Bakelite.

Because machines employed for this kind of work are generally subjected to more abuse and less expert care than those in most other indus-

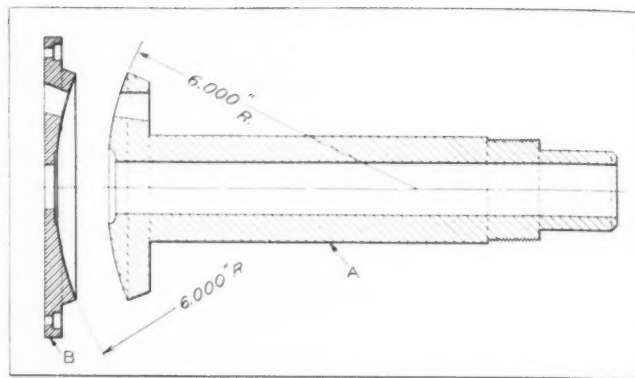


Fig. 1. (A) Convex Half of Valve Made of Cast Bronze; (B) Concave Half Made of Asbestos-base Bakelite

tries, it was believed that a flat surface port valve would be unsatisfactory, due to the difficulty of making a valve of this type 4 1/2 inches in diameter that would retain a flat surface and be steam- and vacuum-tight at temperatures around 300 degrees F. The loading and unloading of the fifteen heads on the machine subject the heads to which the moving half of the valve is attached to considerable jar and side thrust, and any looseness of the spindle on which the head revolves would allow the valve faces to separate on the side to which pressure was applied.

The valve was, therefore, designed with spherical seats or mating faces, as shown in Fig. 1. The spindle to which the Bakelite or revolving half *B* of the valve is attached is given a clearance of 1/32 inch and held loosely at the approximate center of the radius of the spherical seat. With this design, the spherical faces of the valves have a tendency to seat themselves, regardless of any misalignment of the central spindle. When subjected to side pressure, the valve faces are also free to move side-wise until the central spindle comes in contact with the side of the bearing. The two faces of the valve are held in contact by means of a large spring, which can be adjusted to just overbalance the force of the steam pressure on the area of the valve, and so keep it steam-tight. This construction also eliminates trouble from expansion and contraction of the large mass of metal in the heads.

Because a large number of machines were to be built, each having fifteen heads, the cost of the valves became an important item. As the machining of spherical surfaces with the usual type of radius attachment requires careful and accurate tool setting and a high type of workmanship, especially when it is necessary to machine accurately fitted concave and convex surfaces on members that can be assembled just as they come from the lathe without lapping, it was decided to build a radius attachment to handle this work. It was necessary that the attachment be easy to set up, in order to

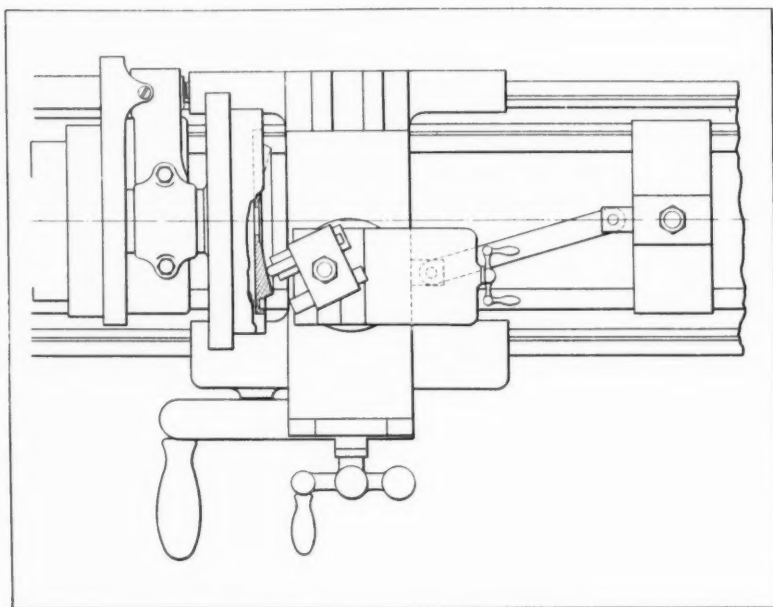


Fig. 2. Plan View of Lathe Attachment, as Used for Concave Turning

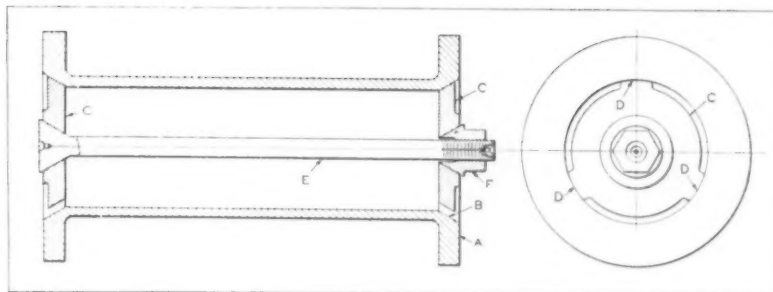
make the duplication of concave and convex surfaces as simple as possible.

In Fig. 2 is shown a plan view of the lathe with the spherical boring attachment in place for boring the concave half of the valve. It will be noted that the fixture is constructed as rigidly as the lathe itself. If all the gibs are adjusted to a snug fit, the tool will travel across the spherical surface smoothly and without backlash or vibration. The finish obtained is equal to that of the best turned work, using similar speeds and feeds.

In Fig. 3 is shown the set-up for turning the bronze half of the valves. This is probably the more difficult of the spherical turning operations, as the work must be supported on centers. Some adjusting of the compound rest is required in order to locate the tool in the correct position. On chucked work or work that is smaller in proportion to the size of the lathe, the set-up will be as simple as that shown in Fig. 2. The lathe used in this instance had a swing of only 9 inches.

Referring to Figs. 2 and 3, it will be apparent that, by knocking out one of the dowel-pins that hold the radius link, or loosening the bolt that holds the tail-block, the carriage and cross-slide will be free to resume their normal functions in performing facing, turning, and chamfering operations. The use of the radius-turning attachment can be resumed as soon as the end of the link is again connected by the dowel-pin.

The set-up for radius-turning can be accomplished quickly, as no time need be spent in setting the tool to the radius required, because this distance is fixed by the dimension between the holes in the link, and the same link is used for both convex and concave work, thus assuring perfect duplication of mating surfaces.



Simple Centering Arbor Used in Facing Operations on Cast-iron Fittings

Centering Arbor for Facing Flanges of Cast-Iron Fittings

By MARTIN H. BALL, Watervliet, N. Y.

The equipment here illustrated has given very satisfactory service in holding flanged fittings and columns of various sizes and lengths while performing facing operations on the ends of the flanges. Work A has a 60-degree chamfer cast in each end, as shown at B. Ordinary casting-cleaning operations consisting of chipping off fins and either tumbling or sand-blasting are performed on the castings preparatory to machining.

The two centering plates C are made of cast iron, and have three equally spaced bearing points D, which makes them self-centering within limits permissible for this class of work; they are made adjustable for the variations that occur in castings by providing tapered center holes. Two centering plates are required for each size of work. The centering plates are taper-bored to an angle of 60 degrees to fit the clamping rod head and nut F, the bores being centered from bearing points D, which are not machine-finished.

Clamping rod E is made in various lengths to suit the different lengths of castings, and is centered and machined accurately at both ends, the thread being cut on centers. Nut F is made of cast iron, and its tapered part is machined while the nut is locked in place on the clamping rod.

In some instances, the flanges of castings A are made square, thus presenting a projection that can be driven by a plain work-driver secured to the faceplate of the lathe. When a round flange is used—the most common practice—a clamp is applied to the work which engages the lathe work-driver.

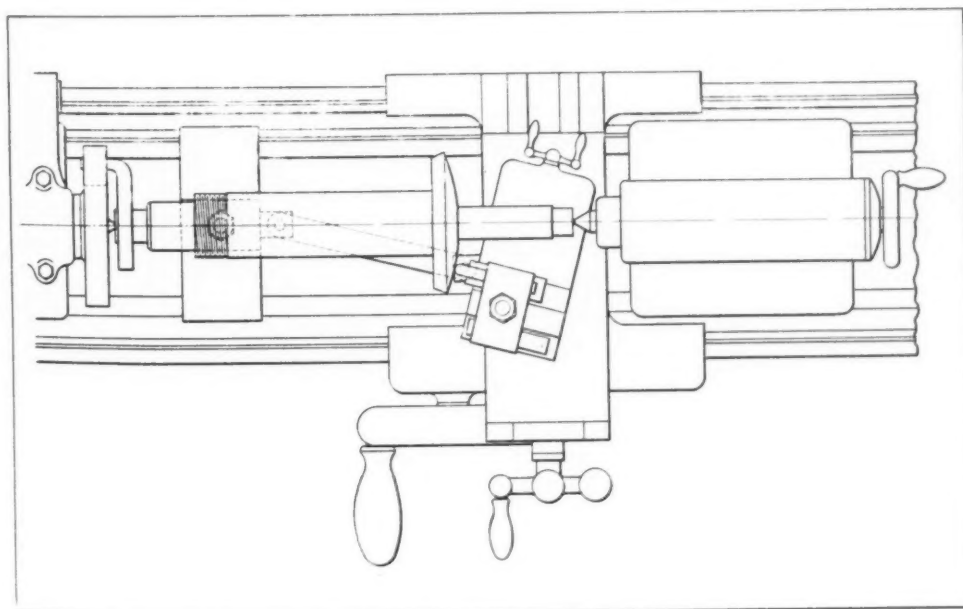
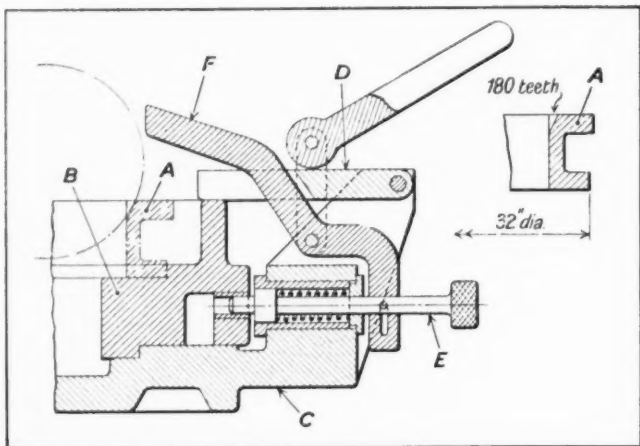


Fig. 3. Lathe Attachment Set up for Turning the Convex, or Bronze Half, of the Valve



Sectional View of an Indexing Milling Fixture Employed for Cutting Internal Teeth in a Ring

Indexing Milling Fixture

The indexing fixture here illustrated was developed for use in cutting 180 equally spaced teeth in a ring A. The work is located by and clamped to a cast-iron ring B, which, in turn, is free to rotate in a cast-iron base C. The cam-actuated clamps D, spaced at regular intervals, hold the rotating ring securely in place. The successive positions of the work are determined by a series of bushings spaced around the ring B. The indexing plunger E, located in the base, engages the holes in the bushings.

When the first tooth has been cut, the clamps D are released and the plunger E withdrawn. At the same time, the hardened bar F, linked to the plunger, falls forward, preventing the cutter from engaging the work. Ring B is then turned until the plunger enters the next indexing hole, after which the ring is clamped for cutting the next tooth. This procedure is repeated for each subsequent tooth.

B. M.

Lathe Tail-Spindle and Center-Drill Holder

By WILLIAM S. ROWELL, Wilkinsburg, Pa.

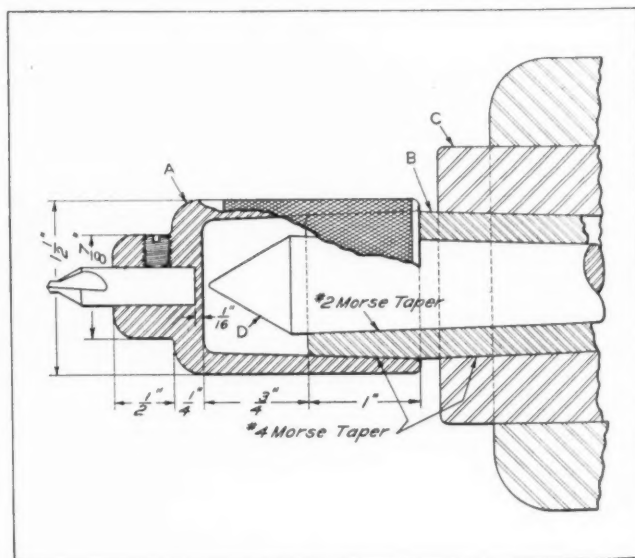
The center-drill holder A shown in the accompanying illustration has proved to be a time- and energy-saver during several years of service. It saves most of the time formerly spent in changing from center-drilling to turning operations and vice versa. It is employed on a lathe with a tail-center B that fits the No. 4 Morse taper in the tail-spindle C. The inserted center D is made from a discarded high-speed steel drill having a No. 2 Morse taper shank. Inserted high-speed steel centers of this kind are suitable for practically all work, but are especially necessary in this case, where the tail-center B has been provided with a tapered end to fit the center-drill holder A, which is of hardened tool steel.

The inserts D are made at very little cost from

the shanks of discarded high-speed drills, and will last much longer than ordinary carbon-steel centers. For use on larger or smaller lathes, all dimensions shown in the illustration must, of course, be changed to suit. The length of the center-drill and holder is kept down to a minimum, because the greater the length the more time will be required for its operation and the greater the overhang of the tail-spindle.

As the use of this center-drill holder necessitates extending and withdrawing the tail-spindle each time it is used, the spindle and its screw should be free-running. To insure this condition, the writer has often drilled a hole in the tailstock to permit trapped air to escape from the spindle barrel in the tailstock when the spindle is being withdrawn and to allow air to enter when the spindle is being extended. If a larger handwheel is needed to operate the tail-spindle, as is often the case, an old valve handwheel of suitable size can be used. To prevent careless workmen from jamming the screw at the end of a back stroke, a stiff short spiral spring should be put in the back end of the spindle barrel which will absorb the momentum of the spindle when it approaches the end of its travel away from the headstock.

It will be seen that, in order to remove the center-drill holder, it is necessary to withdraw the tail-spindle far enough to allow the holder to be removed from the tail-center without moving the tailstock. The 1-inch contact length of the internal taper on the tail-center B secures the center-drill holder A firmly in place. A knock-off arrangement had been planned to facilitate the removal of holder A as the spindle of the lathe is withdrawn, but this is not necessary. Holder A can usually be removed easily by gripping its knurled surface with the hand. A bit of 12-gage sheet copper or brass kept in a convenient place can be used to quickly pry off holder A in case it sticks. The center-drill is secured in holder A by a 1/4-inch headless set-screw.



Lathe Tail-spindle and Center-drill Holder

Electromagnetic Feeler-Gage Control

Newly Developed Gaging Method Used in Inspection Measurements of Small Parts and in the

FOR dimensional inspection of small parts, automatic control of finishing operations, or use with feeler-controlled tools, such as contour milling and die-sinking machines, the electromagnetic indicator gage described in this and succeeding articles has proved practicable. Basically, it consists of an armature pivoted between two magnets, which is deflected through a contacting pin by the work in process or under inspection, so that the magnetic fields of the magnets are strengthened or weakened, with consequent actuation of relays or indicators in the associated electrical circuit.

In Fig. 1 is shown an arrangement of the gage for dimensional inspection on a quantity basis of high-precision parts. The piece *E* to be inspected is placed on the table *H* under the tracer pin *D*. The gage is so fixed that for exactly the right dimension, the armature *B* (supported by leaf spring *C*) is midway between the two magnets *A*. This setting is effected by means of master pieces or precision gage-blocks, and exact adjustment to the desired setting is accomplished by means of the set-screw *F* which turns the swivel key *G*. Backlash or wear is avoided because no gears or bearings are used.

If the piece being inspected is too small, the weight of the armature and suspended pin (about 10 1/2 ounces) causes the armature to be pulled downward until the tracer pin comes in contact with it, causing an intensification and weakening, respectively, of the two magnet fields. Similarly, when the piece is too large, the consequent upward deflection of the pin and armature causes an opposite strengthening and weakening of the two magnet fields.

Any resultant change in field intensity produces a current variation in an associated

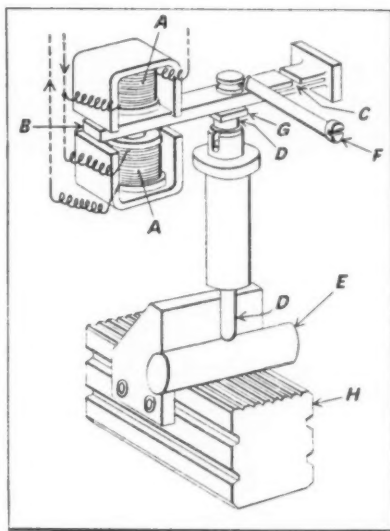


Fig. 1. Arrangement of Electro-magnetic Gage for Dimensional Inspection of External Diameters

eter measurement this entire unit is mounted on a supporting arm which can be vertically adjusted on a pillar. The dimensional capacity of the instrument is 100 millimeters, or 3.937 inches, and the measuring range can be selected from plus or minus 10 microns (0.0004 inch) to plus or minus 100 microns (0.004 inch). Accuracy of measurement is within plus or minus 1 per cent of the range throughout.

Use of Electronic Relay Permits Remote Indication and Control

By amplifying the changes in measurement current caused by movement of the armature, remote indication or control of movement can be effected. For this purpose, the voltage measured by the Wheatstone bridge is stepped up by transformer *D*, Fig. 2, and applied to an electronic tube of the

Thyratron type. This type of tube is designed so that a very small change of potential in the grid or control circuit causes the tube to ignite or be extinguished. When ignited, current flows through the controlled circuit operating mechanical relays or indicating devices. When extinguished, the current flow stops, so that, actually, the tube

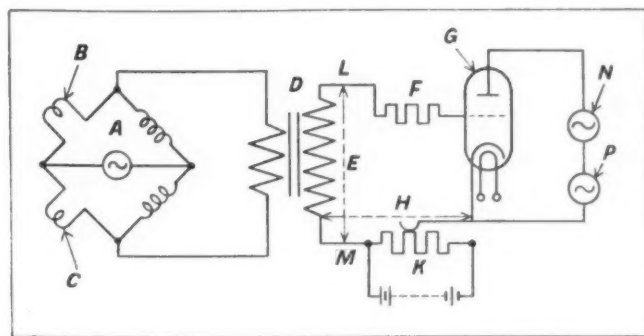


Fig. 2. Diagram of Electric Circuit for Simple Dimensional-control Application

Automatic Control of a Grinding Machine—First Installment of a Series of Articles

Wheatstone bridge circuit (Fig. 2), which is transmitted to an indicator. This indicator has a pointer which is deflected either to the right or left in accordance with plus or minus deflections of the specimen being inspected, and may be read to about 0.001 millimeter (0.00004 inch). Electric power at six volts is supplied through a portable transformer, and voltage fluctuations are compensated for by suitable means.

The armature and magnets of the measuring head are enclosed in a case, and for external diam-

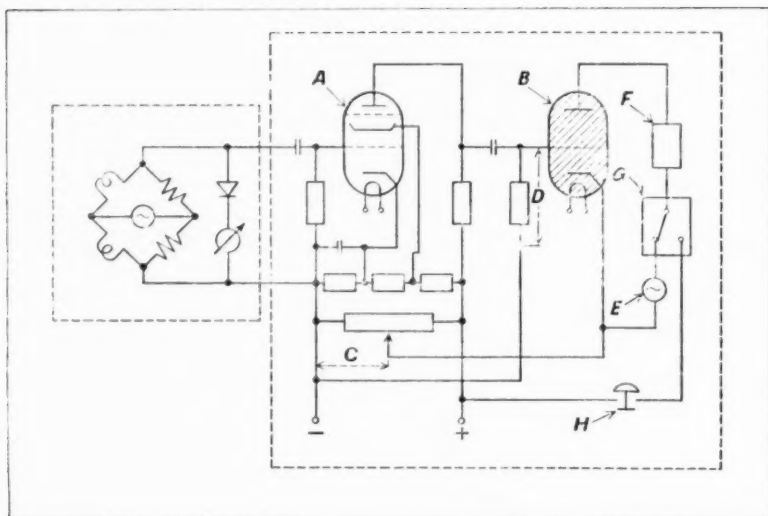


Fig. 3. Use of Amplifying Electronic Tube for Increasing Sensitivity of Measurement

acts as an exceedingly sensitive relay. Because the limit value of the grid voltage igniting the vacuum tube need only be changed by a very small amount to produce ignition or extinction, the accuracy obtained is greater than that of the mechanical relay. Even with a deflection of the tracer pin of the measuring gage of 0.001 millimeter (0.00004 inch), the vacuum tube can be caused to ignite.

Another electrical circuit which serves to amplify the measuring potentials to about 70 volts without reacting on the load of the bridge is shown in Fig. 3. With this amplified voltage, the Thyatron relay B, which has a very constant ignition voltage, can be ignited within an accuracy of 2 per cent of the maximum measuring voltage; in other words, the control system will function with an accuracy of 0.000008 inch for an instrument having a measuring range of 0.0004 inch. With the aid of stabilizers and iron hydrogen resistances, together with the careful selection of vacuum tubes, this accuracy can be maintained over long periods, even though the line voltage averages as much as plus or minus 10 per cent.

Here, again, an adjustable direct-current grid voltage C is connected in series with the amplified measuring voltage D, with the result that ignition will take place only when the amplitude of voltage D exceeds the difference between the adjusted initial direct-current voltage C and the ignition voltage of the vacuum tube.

Because the alternating voltage E, connected to the anode circuit of the electronic relay, is practically in phase with the measuring voltage, ignition is effected with maximum anode voltage, thus insuring reliable functioning of the member F to be controlled, which may be a relay signal lamp, automatic switch, or lifting magnet. Due to the functioning of this member F, the anode voltage tends to decrease and change in phase, so that first ignition takes place under somewhat different conditions from the ignition of subsequent positive half waves. Consequently, there is a difference be-

tween the limit value for interruption on a decreasing measuring voltage and the limit value for starting of ignition on a rising measuring voltage.

This small overlapping of limit values at which ignition and extinguishing take place is about 1 micron (0.00004 inch), and can be eliminated where necessary by the use of a constant resistance. If automatic relays or control switches are to be operated without this overlapping, two vacuum tubes are connected in cascade arrangement. The first tube acts as a relay, and the other as a switch. Inasmuch as the second tube does not have a critical igniting point, a rectifying tube is suitable, and its anode current may be used directly for actuating the relays or switches.

In some cases, where the inspection period is exceedingly short, as when large quantities of bolts are tested continuously and the various pieces are passed under the contact pin as quickly as possible, a slightly over-size bolt will cause the signal lamp to be lighted during only one cycle. Because such a short flashing of the lamp may be overlooked, a switch G, Fig. 3, is incorporated to change over to continuous anode voltage once ignition has taken place, so that the signal lamp remains lighted until the push-button H is pressed to interrupt the anode current circuit.

When lamps are used instead of a meter, different colors may be utilized to indicate whether the piece being inspected is over size, under size, or

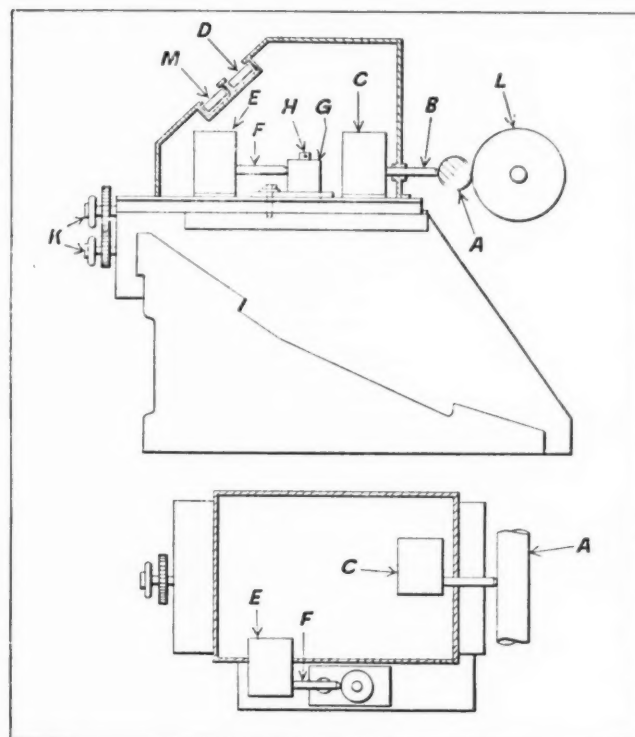


Fig. 4. Electromagnetic Gages Used for Grinding Machine Control

within specified limits. Another arrangement may provide for the automatic sorting out of rejected pieces.

Adaptation to Control of a Grinding Machine

This type of gage has proved to be readily adaptable to the automatic control of several types of machine tools. Thus, in a grinding machine it can be used to stop the wheel feed when the proper size of work-piece has been obtained.

In Fig. 4, the work-piece *A* is engaged by the pin *B* of the measuring head *C*, secured to a measuring table and electrically connected to the indicator *D*. Another measuring head *E* is also carried on the table, and this has a pin *F* which engages the master piece *G* supported by bolt *H*, and is in a fixed position relative to the work. Wherever several diameters must be ground automatically to accurate size, the master pieces can be exchanged accordingly without necessitating the work being removed.

For example, at the first setting, a master piece *G* is slipped over the bolt *H* and a master gage of the same diameter is clamped between the centers of the grinder. By turning the handwheels *K*, the table is moved toward the grinding wheel *L* until the tracer pin *F* of the measuring head *E* just touches the master piece, and the pointer of the indicator *M* registers accurate size. At the same time, the tracer pin *B* of the measuring head *C* bears against the master gage held between the centers. Now, after the tracer pin *B* has been accurately adjusted so that it just touches this master, with the indicator *D* registering exact final size, the master is replaced by work-piece *A* to be ground, with the measuring table fixed at its established position. In grinding this piece to the correct size, the control system connected to the measuring head starts to function when the indicator *D* shows that the desired size has been reached, and the wheel feed is then stopped automatically.

In subsequent settings to obtain different diameters on the work-piece, the master piece need only be exchanged for another of the desired diameter. The measuring table is then shifted until pin *F* just touches the new master piece and the indicator *M* indicates exact final size. The measuring head *C* will then show when the new correct final diameter is obtained by means of indicator *D* and will, at the same time, shut off the machine automatically.

An interesting application utilizes several electronic relays which can be controlled successively, so that the final size of the work can be approached with decreasing speed and pressure. Thus, with two relays, when the final size of the work is nearly reached, the measuring voltage of the gage would have been reduced so that the first electronic relay becomes inoperative. This, in turn, causes the wheel feed to be stopped while the wheel continues running for sparking out until the correct final size is attained. At this point, the grid voltage of the second electronic relay is reduced to such an extent

that it likewise becomes inoperative and the drive to the machine is stopped.

By adjusting the initial voltage of the grid, the values at which the two electronic relays will function can be varied according to the size at which it is desired to cut out the feed motions. Because of their small dimensions, the electric measuring heads can be attached to the machine so that they do not interfere with the grinding operation.

* * *

Skill of Arc-Welding Operators

By W. J. CHAFFEE, Welder Division
Hobart Brothers Co., Troy, Ohio

It has been suggested that comparatively inexperienced men can make satisfactory welds. While it is true that good welds can be obtained by men who have not had extensive experience, the best results from arc welding call for skilled operators who know something more about what they are doing and trying to accomplish than how to mechanically manipulate the welding arc. Contact with large users and with the men who gather at the meetings of the American Welding Society sections has given me the impression that more and more attention is being paid to the qualification of operators, as well as to methods and materials. Welding schools all over the country are now crowded with men learning to weld.

In a textbook used in the factory-operated welding school conducted by the company with which the writer is connected, the following statement is made: "Anyone with average intelligence, a steady hand, and a real desire to perfect himself in the art can readily learn to weld with the electric arc. To become an expert operator, however, requires something more than mere ability to manipulate the welding arc. The man who has had previous training and experience in some mechanical trade will develop more quickly into a proficient welding operator than the man without such training or experience. An experienced gas welder will find it extremely easy to become proficient with the arc, due to his knowledge of metals, welding heats, etc."

In other words, while the desirability of using trained operators should be stressed, it should be pointed out that it is not difficult to obtain the required skill, so that operators can easily be trained, if none should be available to the employer planning to use the arc-welding process. Certainly, better welding may be expected when the operator knows "what it is all about."

* * *

The American Gear Manufacturers Association, 602 Shields Bldg., Wilkesburg, Pa., reports that gear sales for the month of June were 43 per cent above June, 1939. For the six months ending with June this year, the sales were 35 per cent above the corresponding period in 1939.

"Gearbroacher" Equipped to Produce Four Hundred Starter Gears an Hour

ALL the teeth in two nine-tooth automobile starter pinions are broached simultaneously in one stroke of the "Gearbroacher" shown in Fig. 1. This machine is a recent development of the American Broach & Machine Co., Ann Arbor, Mich., and is made in 8-, 12-, and 16-ton capacities. It is designed to produce gears within commercial limits of concentricity and finish at unprecedented speed.

The machine has two chambers in the front vertical section of the column, one above and one below the work-table, as shown in Figs. 2 and 3. The upper chamber has a cross-head actuated by two cylinders in the lower chamber. These cylinders are mounted on each side of the broach elevator. The oil or operating fluid, entering the cylinders at their lower ends, exerts pressure on the full area of the pistons when the machine is operating on the upward or cutting stroke. The cross-head is made hollow to allow two tubular

members to pass through it and through the automatic pull-head to the master work-head. The two tubular members serve as a support for the master work-head, taking the major portion of the pressure exerted against it by the broach on the working stroke.

The machine seen in the illustrations is equipped with two complete sets of broaching tools and fixtures for broaching two gears at a time. The rear vertical portion of the machine houses the electric motor, hydraulic pump unit, and valves. The oil reservoir is located in the lower part of the column with the motor above, both being accessible through a rear door. The electrical control permits the machine to be operated on a full automatic cycle or a semi-automatic cycle.

A set of broaches consisting of the master broach-head and the lower clamping receptacle is shown at *B* in Fig. 5. The illustration also shows the work fixture at *A* and one of the individual

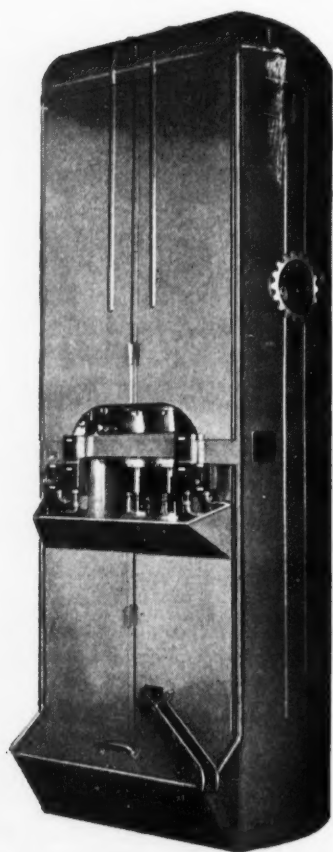


Fig. 1. "Gearbroacher" Equipped for Broaching the Teeth on Two Spur Gears Simultaneously

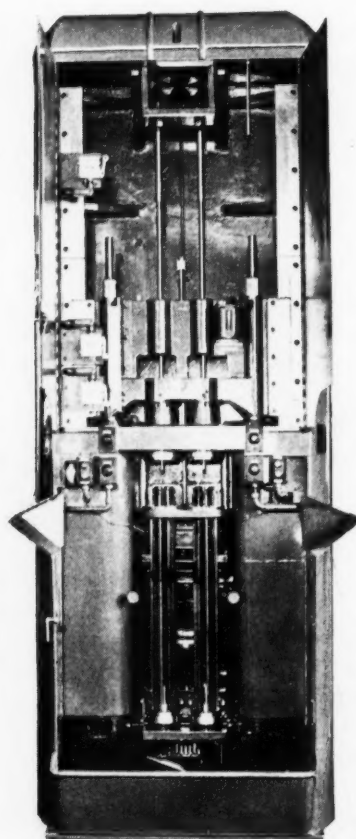


Fig. 2. Front View of Machine with Splash Doors Open and Broaches in Starting Position

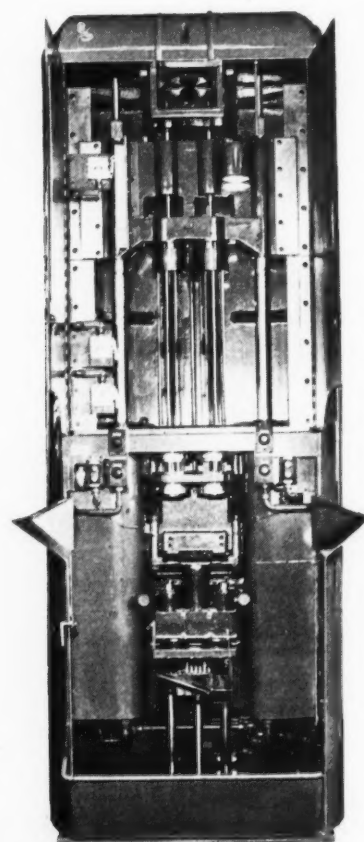


Fig. 3. "Gearbroacher" with the Broaches at Upper End of Stroke after Completing an Operation

Fig. 4. Close-up View of Work Locating Arbors and Broach Shanks, Showing Operator's Left Hand Placing Gear Blank on Left Arbor, and Right Hand Holding Another Blank



broaches at C. These broaches are very accurately ground to conform with the tooth form desired, the back of the broach being ground to a radius to conform with the radius of the inner diameter of the master work-head rings. Two of the broaches are shown in the machine in Fig. 2, ready for operation. The lower end of each broach is clamped in the lower receptacle against a ground inner bushing. The master work-head, which might be termed the fixture itself, receives the work on a stud, as illustrated in Fig. 4. The stud locates the work accurately in a central position with respect to the rings that support the backs of the broaches. There are two rings; the one on the work end of the master head supports the broach at and beyond the work, while the one inside the master head supports the broach at the opposite end of the head. The master head is made to suit each particular gear to be broached, and the slots in the head are ground to very close limits, the clearance between the broach and its slot being approximately 0.0002 inch.

The broach elevator, shown in its lowest position

in Fig. 2, allows sufficient room at the upper ends of the broaches to permit two pieces to be placed on the fixture. The pieces are held in position by spring-loaded detents. When the machine starts, the elevator moves upward, causing the broaches to pass through the master work-head and up into the automatic pulling head. The vertical cross-head then starts moving upward preparatory to taking the cutting stroke, the broach elevator also traveling up at the same time. After the cross-head has moved approximately 1 inch on its upward or cutting stroke, the broaches become automatically locked to the pulling heads.

Upon reaching the guide plate, the broaches leave the lower elevator and raise the guide plate, permitting a spring collet, which is mounted in the lower broach receptacle, to pass over the work as the machine comes to a stop at the end of the cutting stroke. Upon the return stroke, the broached pieces drop through the collet and out the chute at the front of the machine.

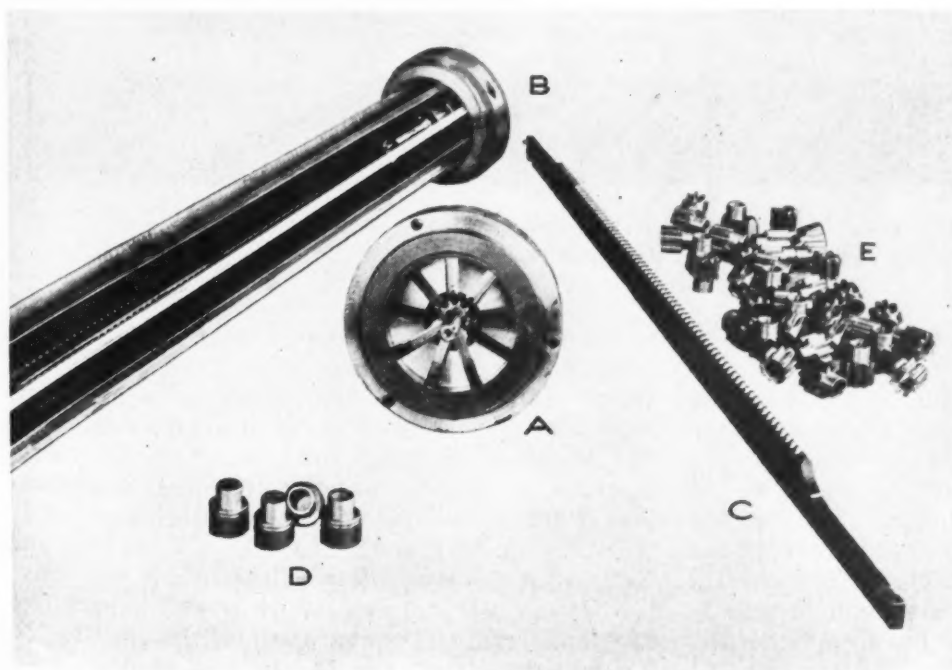


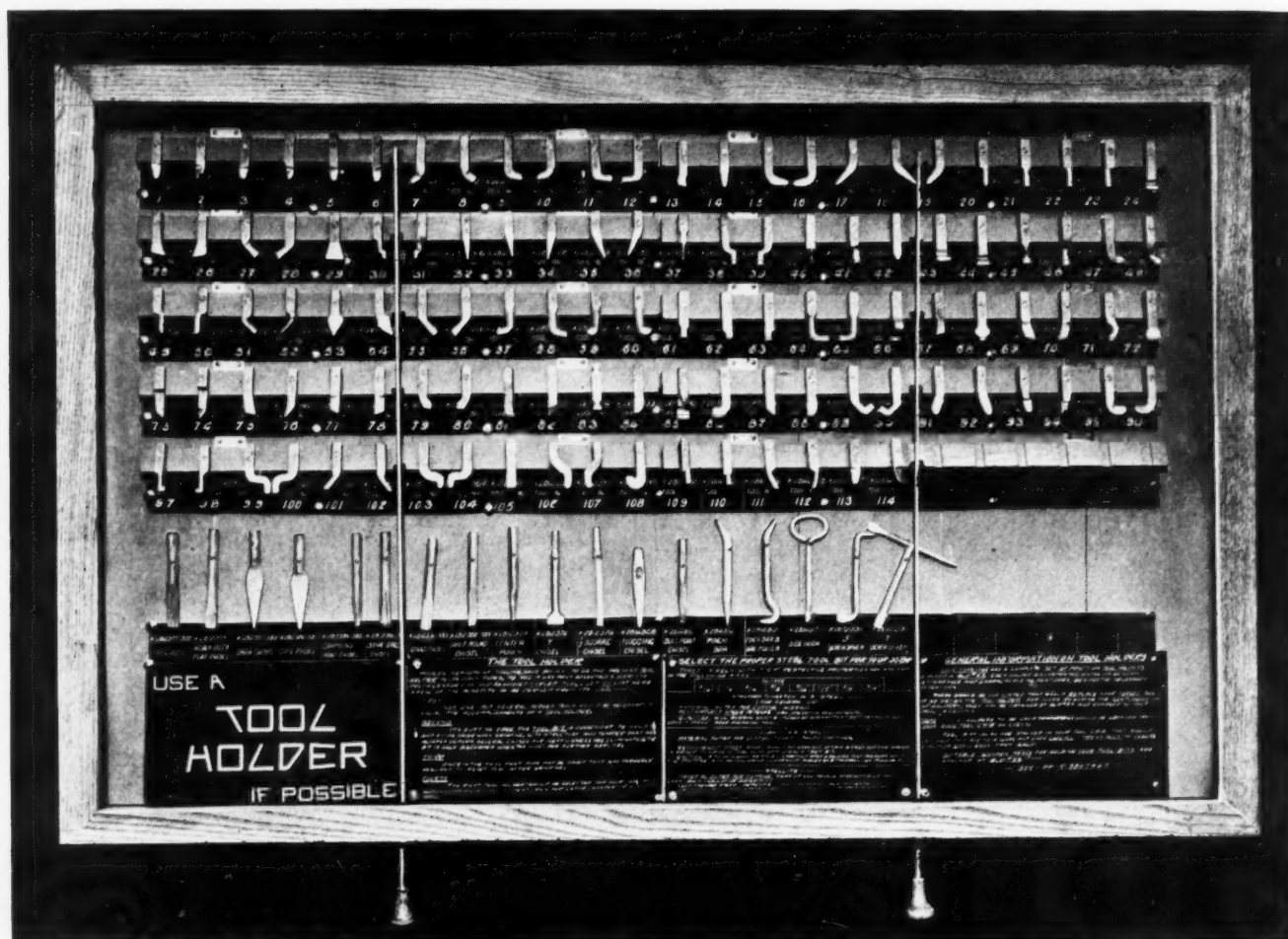
Fig. 5. (A) Work Fixture with Central Stud for Locating the Pinion Blank; (B) Broach for Cutting a Nine-tooth Pinion in One Stroke; (C) One of Nine Tooth-space Broaches to be Assembled in its Lower Receptacle, as Shown at (B); (D) Pinion Blanks to be Broached; (E) Pinions with Broached Teeth

General Electric Display Board With Models of Cutting Tools

Boards like the one shown in the accompanying illustration are hung outside of the tool-cribs in the Schenectady plant of the General Electric Co., with the object of facilitating the selection of tools by operators. These model tools are made from cast iron. The body or shank of the tools is painted red, and the cutting ends white. The tools are mounted on bars which are hinged, so that an end view of the tool may be obtained simply by pushing on the small plunger attached to the bars

National Metal Congress to Be Held in Cleveland

The twenty-first annual National Metal Congress, to be held in Cleveland October 21 to 25, promises to be an outstanding event. The American Society for Metals will have fourteen sessions, besides the educational lectures scheduled for late afternoons and early evenings. Cooperating with the American Society for Metals in this Congress are the American Welding Society, at the meetings of which nearly sixty papers will be presented; the Institute of Metals and the Iron and Steel Divisions



Display Board of Tools, Used in the General Electric Co.'s Schenectady Plant, which Enables Tools to be Inspected from All Sides

extending below the board. The bar then can be turned upward somewhat as a shutter would be operated. In this way, both plan views and end views of the tools can be readily inspected by the operator.

Each standard tool has a number; and, as the cabinets are displayed near the crib window, the operator simply chooses the type of tool needed for his work and calls for it by number. This system replaces the old method of bringing sample tools to the crib, or the making of sketches to indicate the approximate type of tool required.

of the American Institute of Mining and Metallurgical Engineers; and the Wire Association. The Hotel Statler will be the headquarters for the American Society for Metals; Hotel Cleveland, for the American Welding Society and the American Institute of Mining and Metallurgical Engineers; and Hotel Carter, for the Wire Association.

In conjunction with the Metal Congress, the National Metal Exposition will be held in the Cleveland Public Auditorium. With 90,000 square feet of exhibit space reserved already, this will be the largest exposition ever held by the Society.

Fastenings for Die-Cast Parts

Various Methods Employed for Fastening Die-Castings to Other Parts of Devices or Mechanisms

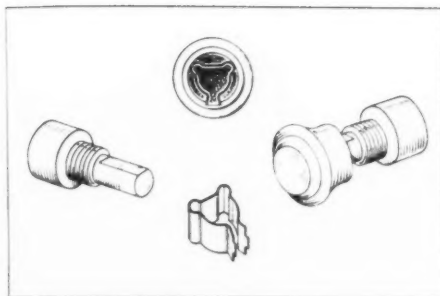


Fig. 1. Die-cast Knob with Spring Clip for D-shaped Shaft

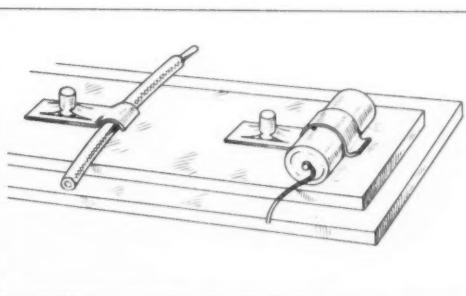


Fig. 2. "Speed Nut" Straps Used to Support Small Cylindrical Parts

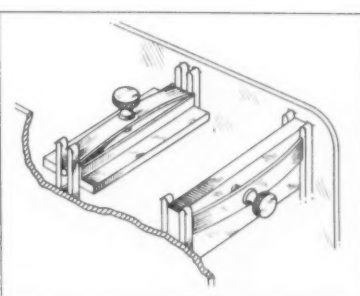


Fig. 3. Bowed Spring and Thumb-screw Fastening

IN machine design, it often becomes necessary to provide some means for fastening die-castings to other parts of the machine, mechanism, or device being built. The present article will describe a number of such fastening means.

In the hollow die-cast knob for a rotary switch, Fig. 1, a hole slightly smaller than the hub is cored, with a keyway at one side. The knob is fastened to the D-shaped shaft by a Tinnerman "speed clip" of tempered spring steel having the shape shown. The ends of the clip fit into the keyway, so that it cannot turn in the hole. The central portion of the clip makes a snug fit on the shaft, the flat portion pressing firmly against the flat on the shaft, so that the shaft cannot turn in relation either to the clip

or to the knob. No tools are required for assembly, and no drilling or tapping is necessary.

Such parts as small cylindrical condensers or wires often have to be fastened to die-castings. The latter are readily provided with integral studs of either circular or D-shaped section. A strap or support for the part can then be formed integral with a "speed nut," as in Fig. 2. This nut is then pressed over the stud, and securely anchored by the ears, as shown. If the stud is of D-shaped section, a quarter turn of the nut will release it. No tools are needed for assembly or for removing the nut.

If it is desired to fasten a die-cast part arranged to slide in opposing slots of another die casting, as in Fig. 3, use can be made of a bowed spring with

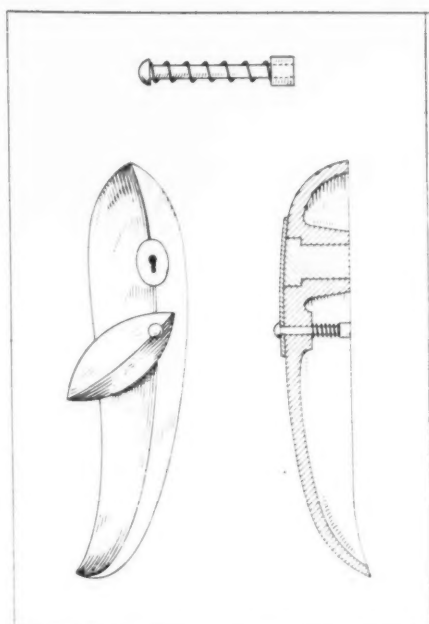


Fig. 4. Car Handle with Spring-held Lock Shield

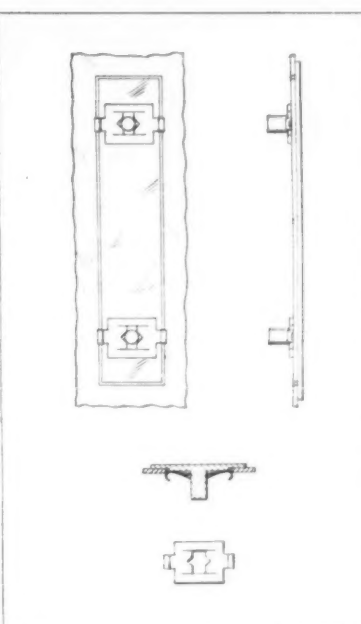


Fig. 5. "Speed Clips" Used on Die-cast Studs

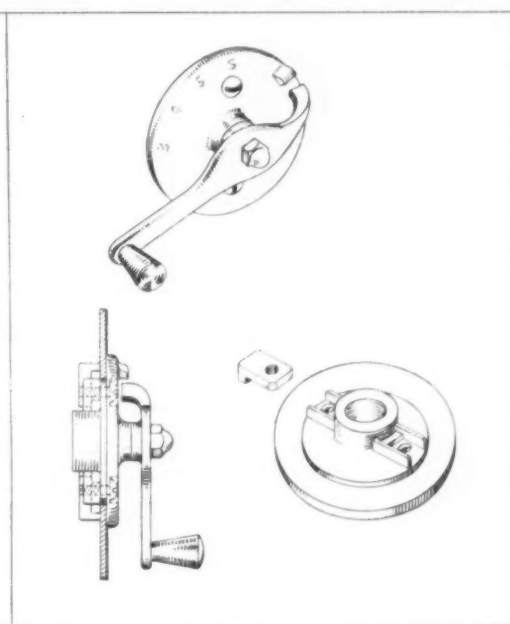


Fig. 6. Die-cast Flanged Part with Hub and Boss on Opposite Sides of Flange

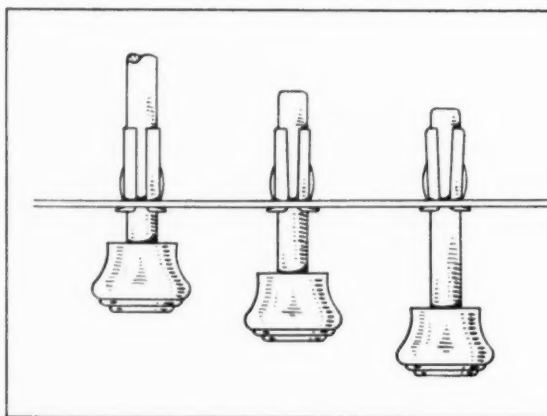


Fig. 7. Die-cast Knobs with Clip Fastenings

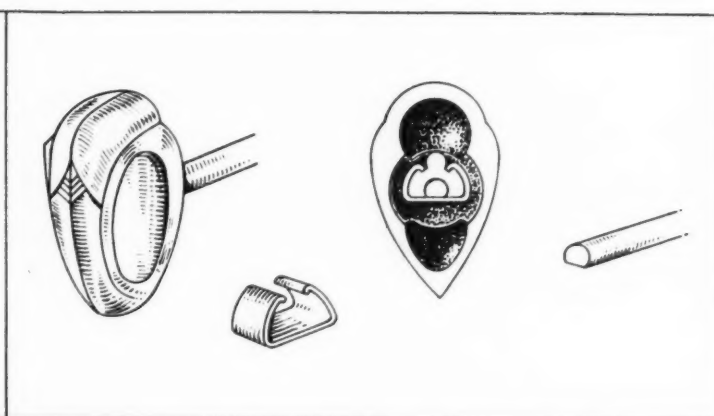


Fig. 8. Switch Handle with "Speed Clip" Fastening for D-shaped Shaft

a hole punched in its center and a thumb-screw passing through the hole and threaded into the movable part. Tightening the screw lengthens the bowed spring and causes it to lock against the side of the slot, as indicated. Or, if preferred, the spring may straddle the slot and bear at both sides. This is a frictional fastening, but can be made quite secure, is easily adjustable, and is not likely to loosen, as the screw is under tension.

Die-cast deck-handles for Mercury cars are provided with a stamped stainless-steel shield to exclude moisture from the lock, as shown in Fig. 4. The shield is fastened to the handle by a dome-headed pin which is a press fit in a small collar and a loose fit in the handle. A helical spring on the shank of the pin draws the shield tightly against the handle.

Take-out plates are often die-cast with integral studs, and can be held in place by "speed clips" of the type shown in Fig. 5. This clip is anchored to the stud in the same way as a "speed nut," but its ends are curved backward and are made yielding, so as to spring inward when the plate is pressed into the hole it is to cover. The ends of the clip immediately spring outward again to grip the edges of the hole and hold the plate in place, at the same time permitting ready removal when required. The opening covered by the plate is slightly narrower than the length of the clip, as shown in the illustration, but similar clips can be used on wider plates if the studs are spaced the correct distance from the edges of the plate.

The flanged part with a hub, Fig. 6, is die-cast so that the boss on the rear face fits a hole in which the piece must turn for

angular adjustment, and yet be locked at required positions indicated by numbers on the flange of the casting. Two screws pass through the flange and into L-shaped nuts, which are also die-cast and are prevented from turning by ribs at each side of each nut. The ends of the nuts bear against the face around the hole (at a diameter somewhat larger than that of the hole). Opposite ends of the nuts rest on ledges next to the hub. When the screws are loose, the flanged hub can be turned to any desired position, but when the screws are tightened, they hold the casting securely against turning. All the parts seen in the illustration, except the screws and the acorn nut, are die-cast in zinc alloy.

Die-cast knobs or buttons are often provided with integral studs or with rods, sometimes cast in place, to extend through holes in panels or mating parts. Clips of the shapes shown in Fig. 7 may prove convenient in such cases. These clips have one flanged end which fits against the plate, and at the back of the plate, have ears which prevent the clip from pulling out. The back end of the clip is either left straight, in which case the stud or rod is a slidable tensioned fit suitable for push-pull applications, or may be curled inward. Considerable inward curl produces a locking action, preventing withdrawal. Somewhat less curl will hold the rod or stud at any desired position, but still permit of adjustment. The clips are inserted without tools and are especially useful when the hole is not accessible from the rear.

Handles, such as those used for a switch or cock, Fig. 8, can be fastened to a stem by the "speed clip" shown. This is made to fit

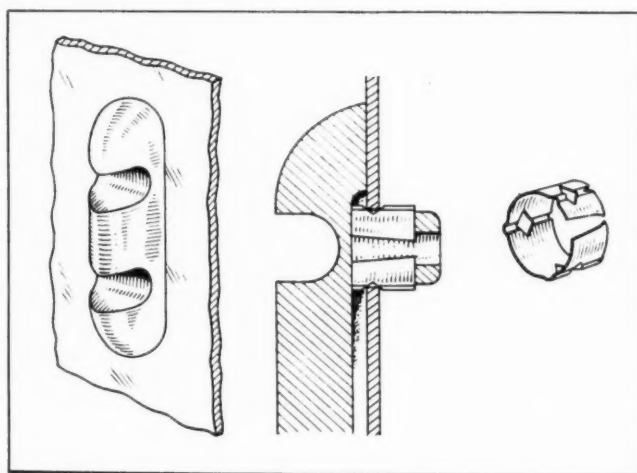


Fig. 9. Clip Fastening for Shelf Support

around a hub which is open at one side where the clip is flattened to bear against a corresponding flat on the stem. The latter is from 0.005 to 0.010 inch farther from the center than the flat on the hub, and when the chamfered stem is pushed into the opening, the clip bears tightly against its flat and prevents the stem from turning inside the clip. The ends of the clip bite into the metal and prevent it from coming off if the handle is pulled. No tools are required for assembly, and the handle can fit close to the face, since there is no set-screw to be reached. Although the hold is by friction, it is secure and, at the same time, permits the handle to be readily removed if required.

Stainless-steel collar clips such as shown in Fig. 9 are used to fasten shelf supports to the interior walls of refrigerators. Holes for the clips are punched before the inner shell is put in place, and access to the outer face of the shell is almost impossible thereafter. The collars have three diamond-shaped holes, at each side of which the metal is bulged outward. When the collars are expanded in the hole, the sheet metal of the shell fits into the diamond-shaped openings of the clip and locks the latter against axial motion.

The shelf supports are plastic moldings which are made with integral projections that fit the expanded collars and are held by friction, but cannot pull out when the shelf is in place. If the shelf is improperly tilted when being removed or inserted, the plastic shelf support may be broken. Use of the clip permits of easy removal of a broken support and insertion of a new one without access to the insulation space outside the shell. The shelf supports could also be readily die-cast and plated, in the same shape as the plastic supports. They could make use of the same type of fastening and, like the plastic part, would require no drilling or threading.

* * *

Simplified Practice Recommendation for Files and Rasps

Printed copies of the recent revision of Simplified Practice Recommendation R6-40 covering files and rasps are now available from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents a copy. The simplification of files and rasps was first undertaken by the industry in cooperation with the War Industries Board in 1918. At that time, the number of varieties was 1351. The current revision brings the number of stock varieties down to 377; this is 28 per cent of the number of varieties produced before 1918, which were gradually reduced by the 1918 and 1923 revisions.

* * *

Contrary to popular conception, there is no silver in nickel silver. This material is an alloy of nickel, copper, and zinc.

Unshackle Arc Welding and Speed Progress

By C. M. TAYLOR, Vice-President
The Lincoln Electric Co., Cleveland, Ohio

It is altogether unreasonable that a valuable industrial process such as arc welding, which has already created tremendous industrial and social benefits, and which will create still greater advances in the future, should be held back by restrictions and regulations that contribute nothing constructive, but only serve to impede progress.

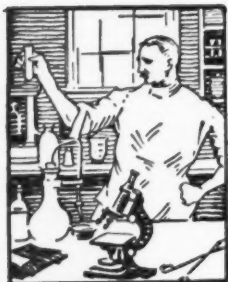
The worst feature of these restrictions is that the public many times questions the reliability of welding. As J. F. Lincoln, president of our company, pointed out in a recent article that was widely quoted, there is no mystery in welding. The properly trained and capable welder will consistently make welds stronger than the welded steel plate, just as properly trained and able machinists will consistently turn out work machined to the closest tolerances.

Does someone stand over the trained mechanic checking every nut he turns to make a bolted connection? Is the trained riveter beset by inspectors on every rivet he drives? Are these trained craftsmen required to pass a test at frequent intervals to qualify for work which they have been doing for years and for which their experience and ability make them fully capable? Is every single riveted and bolted connection individually examined, inspected, and tested? Obviously, the answer to all of these questions is "No!"

Yet the present trend in regard to arc welding is in that direction. So many codes, tests, inspections, provisions, restrictions, regulations, etc., are being imposed upon the process that the benefits it inherently creates are seriously affected. Arc welders are severely handicapped, not only by frequent interruptions to permit inspection of work in process, but also by having to be qualified over and over again for a type of work for which they have previously been fully accredited. There is no more justification for this state of affairs in welding than in any other craft or trade; in fact, there is less justification. Good welders assure the quality of the weld by *observing the inside of the joint as it is being made*, which is not possible with other less supervised methods of construction.

These restrictions are due simply to misunderstanding of the basic principle of arc welding, and are highly unfair to welders. The experienced welder knows that the benefits which arc welding creates stimulate expansion of his own industry, and by doing so broaden his opportunities for employment and assure his continued earnings. The good welder is a capable, conscientious worker, upon whom all of the inspection and qualification tests serve only to work hardship. He wants these restrictions removed in order that he may be free to do his work properly, and that the way may be cleared for further development of his industry.

MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES



Protection for Stainless Steel During Storage and Shipping

Stainless-steel sheets and materials can be protected during storage, fabrication, and shipping by a new compound recently placed on the market by Paisley Products, Inc., Chicago, Ill. This compound, which is used in conjunction with ordinary wrapping paper, may be brushed either on the metal or the paper, and forms an adhesive which holds the paper as a tight, smooth coating when spread over the stainless-steel sheet. It is claimed that the paper will provide effective protection against abrasion and scratches during handling, and also that it affords an excellent surface for lay-out work. The paper and compound can be removed by washing with warm water.....201

Some Advantages of 3 1/2 Per Cent Nickel Steels

Because of the fact that after nitriding, a steel containing 3 1/2 per cent nickel is capable of withstanding higher unit pressures without spalling than other nitrided steels, it is receiving favorable attention for such applications as plug gages, as well as knuckle-pins for radial aircraft engines. Its ability to precipitation-harden at the temperature at which nitriding is carried out also assures a stronger supporting core. Thus it is being considered for parts where the distortions due to high temperature heat-treatment are most difficult to control. 202

New Enamel Brings Color to Plain Plastics

The Sherwin-Williams Co., of Cleveland, Ohio, has recently developed a new enamel which can be used to coat inexpensive, plain, plastic material with beautiful iridescent colors. The new enamel is called "Kem Bakolescent" in the iridescent form, and "Kem Plastite" in solid color form. Both types provide good surface-wearing properties. They can be applied by either dipping or spraying. Molded

parts for vacuum cleaners, electrical wiring devices, radio cabinets, and automobile parts are being coated with these new enamels.203

Tred-Seal—A New Waterproofing and Crack-Filling Material for Floors

A waterproofing, crack-filling, and splinter-proofing material for wood or concrete floors has been brought out under the name of "Tred-Seal" by the Rock-Tred Co., Inc., 629 W. Washington Blvd., Chicago, Ill. The material is applied by a steel trowel, and is said to be ready for heavy service in six hours. The main advantage claimed for this material is the saving on maintenance and replacement of wood floors in warehouses, factories, etc. Only a thin film of the material is required to splinter-proof a wooden surface, one gallon covering about 75 square feet.....204

Powdered Metal Produces Steel Parts of High Quality

There is now on the market a powdered metal which can be pressed into practically any desired shape and then sintered to produce a dense, homogeneous steel which, under the microscope, shows the usual steel constituents. In many cases, the use of this material will eliminate metal losses, and parts can be exactly duplicated without expensive and difficult machine work. It is claimed to be suitable for the production of such parts as gears, cams, pump rotors, washers, pins, rivets, and splined shafts. This material is known as "Sinterloy," and is being marketed by Charles Hardy, Inc., New York City.

Forming to the required shape is accomplished at a pressure of 50 tons per square inch. Sintering is conducted in a controlled atmosphere to prevent oxidation and decarburization. Six to eight hours is usually required at from 1965 to 2100 degrees F. in the ordinary furnace, or two hours in a high-frequency induction furnace. For maximum density, parts may be re-pressed after sintering.

The powdered metal is available in three com-

positions having 0.15 per cent, 0.40 per cent, and 0.80 per cent carbon. Each of these compositions contains carefully determined amounts of chromium, and 1.5 to 3 per cent nickel may be added where toughness is desired. The first two of these compositions are suitable for casehardening by the pack-hardening method. The second composition, containing 0.40 per cent carbon, can be heat-treated to a hardness of Rockwell C 40 (Brinell 370), while the third composition, containing 0.80 per cent carbon, can be hardened to Rockwell C 50 (Brinell 485). It is claimed that tensile strengths of from 80,000 to 120,000 pounds per square inch have been obtained. Marked resistance to wear and a lower ductility than that of many ferrous alloys are also characteristic of this material, and, in general, it is said to compare well with cast steel and cast alloy steel.....205

Wire with Surface Impregnated by Dry Lubricant

The possibility of producing wire with a surface impregnation of dry lubricant for applications where the lubricant would prevent binding, sticking, and wear is forecast as the result of a discovery to which attention has been called by the Acheson Colloids Corporation, Port Huron, Mich. Peculiarly enough, the discovery was made in connection with the production of wire in which the presence of such a lubricated surface was actually not desired.

For some years, it has been customary to use colloidal graphite as a lubricant in drawing fine wire such as is used for tungsten filaments. Such wire comes out of the dies dark in color, due to the presence of particles of colloidal graphite. In using the same method of drawing-die lubrication during the production of stainless-steel wire, it was discovered that the graphitic coating could not be removed by the usual methods of washing. When this type of wire was drawn through the dies, the pressure created what is known as a "graphoid"

surface on the wire; that is, extremely fine colloidal graphite particles had been intimately combined with the metal as part of the surface of the wire. This is the same condition as is encountered after a period of time in machinery lubricated with colloidal graphite suspended in oil. In that case, the graphoid surface provides good dry lubrication and reduces the tendency to stick, even in the absence of other lubricants.

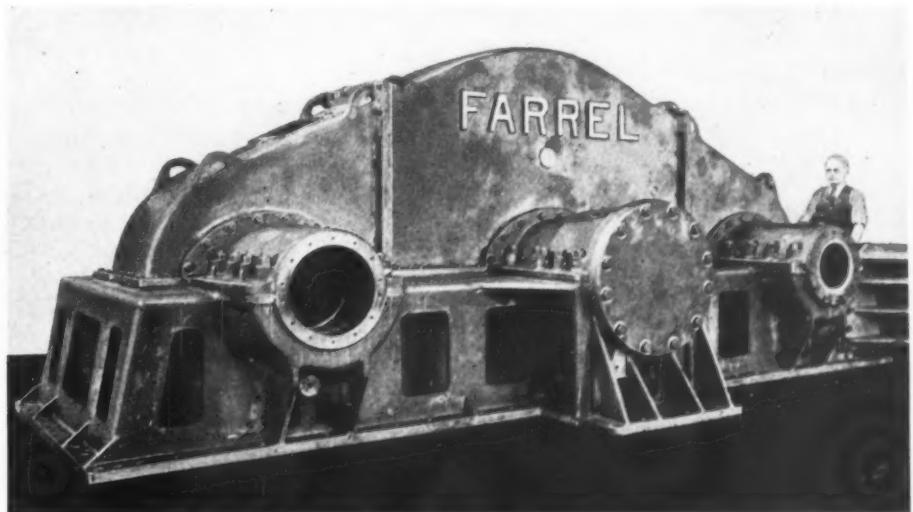
An additional advantage of wire drawn with colloidal graphite lubricated dies may be found in a certain amount of resistance to corrosion. In the case of stainless-steel wire, this additional protection, of course, is not necessary. It may offer possibilities, however, in reducing costs in the production of wire requiring some amount of protection against corrosion, since it may eliminate an extra operation that is usually needed to provide corrosion resistance.206

Solid Plastic Block Replaces Several Indicator Parts

Glass tubing and delicate moving parts that were formerly necessary in the construction of a carbon-dioxide indicator made by the F. W. Dwyer Mfg. Co., of Chicago, Ill., have been eliminated by using a solid block of Lucite, a crystal-clear methyl methacrylate plastic produced by E. I. du Pont de Nemours & Co. The necessary passages for the absorbent fluid that indicates the volume of carbon dioxide are drilled directly in the plastic. Since light suffuses the instrument from all sides, accurate readings can be taken even under poor lighting conditions.

Exceptional compactness and light weight, together with freedom from breakage, were obtained through the use of this material. The absorbent fluid has no effect on the plastic. The same principle has been applied by this company in the manufacture of portable draft gages, which are sensitive to extremely slight fluctuations in pressure or air velocity.....207

Huge Housing for Two-pin-ion Reduction Units Built by the Farrel-Birmingham Co., Inc., Ansonia, Conn., for Ships Constructed for the Maritime Commission. The Castings Used in These Housings are of Meehanite Metal Having a Minimum Tensile Strength of 40,000 Pounds per Square Inch, Except the Bearing Caps, which are of Meehanite Having a Minimum Tensile Strength of 50,000 Pounds per Square Inch



To obtain additional information about materials described on this page, see lower part of page 132.



Machines and Tools for Apprentice Training

SOUTH BEND LATHE WORKS, 725 East Madison St., South Bend, Ind. Publication entitled "Planning the Industrial Apprentice Training Shop," containing a number of shop lay-outs planned for efficient vocational training; information on methods of organizing for shop work; suggestions for the selection of equipment; and lists of tools and accessories for various sizes of apprentice machine shops.1

Electrical Equipment

WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. Leaflet F-8537, on Type FS general-purpose, polyphase, squirrel-gage, induction motors, 1/6 to 3/4 H.P. Descriptive Data No. 3705, on squirrel-cage induction motors, 250 H.P. and larger. Booklet B-2243, on De-Ion air circuit-breakers. Leaflet F-8494, on a small universal motor suitable for adding machines and many other light-duty drives.2

Tool Steel

CARPENTER STEEL Co., 105 W. Bern St., Reading, Pa. Bulletin entitled "Spotlighting a New Hidden Way to Get More from Your Present Production Set-up," containing case records of how production has been increased on press and die work by the use of the Carpenter Matched Set Method through which the correct tool steel can be selected for different classes of work.3

Electric Equipment

GENERAL ELECTRIC Co., Schenectady, N. Y. Circular GES-2285, entitled "Has This Ever Happened to You?" descriptive of Type Airs regulators for proper voltage control. Circulars GEA-3307 and 3352, describing, respectively, self-starting synchronous inductor motors, and fractional-horsepower sump pump motors.4

Combination Tool-Room Machine

HANNIFIN MFG. Co., 621-631 S. Kolmar Ave., Chicago, Ill. Bulletin 51,

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Check on Form at Bottom of Page 131 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the August Number of MACHINERY

descriptive of the Hannifin No. 10 tool-room machine which combines in one unit a precision lathe, sensitive drill press, horizontal milling machine, and vertical milling machine.5

Centerless Grinding and Lapping Machines

CINCINNATI GRINDERS INCORPORATED, Cincinnati, Ohio. Catalogue G-456, illustrating and describing the Cincinnati No. 2 centerless grinding machine. Publication G-453, illustrating, describing and giving specifications of the Cincinnati centerless lapping machine.6

Testing Bond Hardness of Abrasives

FOSTER MACHINE Co., 702 Foster Bldg., Elkhart, Ind. Booklet entitled "Foster-Rockwell Test. Bond Hardness of Abrasives," covering the checking of the bond hardness of fine-grit abrasives used in super-finishing operations.7

Foundry Cleaning Equipment

AMERICAN FOUNDRY EQUIPMENT Co., 399 S. Byrkit St., Mishawaka, Ind. Circular 14, illustrating and describing the Wheelabrator, a combination tumbling and table type cleaning machine. Circular 32, on the Cyclone dust collector for foundry use.8

Contour Sawing Machines

CONTINENTAL MACHINES, INC., 1312 Washington Ave., S., Minneapolis, Minn. Circular entitled "Eminent Engineering," illustrating and

describing the outstanding precision features of Doall internal and external contour sawing and band filing machines.9

Machine Tools and Small Tools

PRATT & WHITNEY DIVISION NILES-BEMENT-POND Co., West Hartford, Conn., is distributing a new publication known as "Backgrounds," intended to inform the reader of current progress in the use of tools, gages, and machine tools.10

Flexible Couplings

LINK-BELT Co., 307 N. Michigan Ave., Chicago, Ill., Catalogue 1845, containing complete dimensional and price data on Link-Belt flexible couplings, together with selection tables and instructions for installation and lubrication.11

Thermo-Couples

LEEDS & NORTHRUP Co., 4934 Stenton Ave., Philadelphia, Pa. Catalogue N-33A(6), entitled "Thermo-Couples — Assemblies, Parts, and Accessories," containing a great deal of important information for thermo-couple users.12

Bronze Bearings

MORaine PRODUCTS DIVISION, GENERAL MOTORS CORPORATION, Dayton, Ohio. Catalogue listing available sizes of Durex bronze bearings, also showing gears, pistons, cams, eccentrics, etc., made by powder metallurgy.13

Universal Bench Bender

O'NEIL-IRWIN MFG. Co., 316 Eighth Ave. S., Minneapolis, Minn. Circular describing a universal bench bender by means of which pipe and wire of all shapes can be formed to exact circular, odd, or irregular shapes, as required.14

Filters

CUNO ENGINEERING CORPORATION, 417 S. Vine St., Meriden, Conn. Booklet entitled "Eighty Ways to Make More Money," describing eighty actual case histories of Cuno continuously cleanable filters at work in industry.15

Milling Machines

CINCINNATI MILLING MACHINE & CINCINNATI GRINDERS INCORPORATED, Cincinnati, Ohio. Catalogue M-865, illustrating and describing the new Cincinnati 28-inch vertical Hydro-Tel milling machine. 16

Machine Tools, Molding and Die-Casting Machines

REED-PRENTICE CORPORATION, Worcester, Mass. Bulletin entitled "Over 75 Years Experience," showing the manufacturing facilities and the lines of products of the company. 17

Drill Rod

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York City. Folder entitled "Crucible's Full-Range Drill Rods," listing drill rod available in every standard size, shape, length, and finish. 18

Tool-Room Milling and Drilling Machine

BLANK & BUXTON MACHINERY Co., 620 N. Mechanic St., Jackson, Mich. Circular describing milling, drilling, and boring machines for tool, die, and experimental shops. 19

Self-Lubricating Bearings

JOHNSON BRONZE Co., 520 S. Mill St., New Castle, Pa. Data sheets on Johnson Ledaloyl self-lubricating bearings, covering physical characteristics, operating temperature, and method of installation. 20

Ball Bearings

NEW DEPARTURE DIVISION GENERAL MOTORS SALES CORPORATION, Bristol, Conn. Circular A-287, describing the application of New Departure ball bearings in vertical tension or idler pulleys. 21

Allegheny Metal

ALLEGHENY LUDLUM STEEL CORPORATION, Pittsburgh, Pa., Blue Sheet 108, on Allegheny metal wire products. Bulletin A-11, sections 1 and 12, giving prices for Pluramelt and Allegheny metal castings. 22

Adjustable Die-Heads

EASTERN MACHINE SCREW CORPORATION, 23-43 Barclay St., New Haven, Conn. Bulletin 40, on a new, inexpensive type of H & G solid adjustable die-head, equipped with high-speed insert chasers. 23

Thermometers and Pressure Gages

BROWN INSTRUMENT Co., Wayne and Roberts Aves., Philadelphia, Pa. Catalogue 6705, covering indicating, recording, and controlling thermometers and pressure gages. 24

Coolant Pumps

RUTHMAN MACHINERY Co., 200 Pike St., Cincinnati, Ohio. Circular announcing a new small-sized Gusher machine tool coolant pump embodying all the advantages of the larger pumps in this line. 25

Turret Lathes and Automatics

GISHOLT MACHINE Co., 1209 E. Washington Ave., Madison, Wis. Performance Data Sheets Nos. 46 to 49, giving production data on four different jobs handled on Gisholt automatic lathes and turret lathes. 26

Welding Electrode Chart

LINCOLN ELECTRIC Co., Cleveland, Ohio. Chart giving uses, physical characteristics, etc., as well as currents and welding procedures for thirty-six different arc-welding electrodes. 27

Impact Briquetting Machine

DOELGER & KIRSTEN, INC., Milwaukee, Wis. Circular describing Grob impact briquetting machine for producing two tons of briquettes an hour from cast-iron borings. 28

Hydraulic Equipment

BLACKHAWK MFG. Co., Milwaukee, Wis. Catalogue 40H, covering the company's complete line of hydraulic hand- and power-operated equipment, including jacks, pipe-benders, etc. 29

Heat-Treating Furnaces

LITHIUM CORPORATION, 175 Fifth Ave., New York City. Bulletin describing Litheco atmosphere furnaces for obtaining satisfactory results in hardening and heat-treatment. 30

Carbide-Tipped Tools

SUPER TOOL Co., Box 68, Harper Station, Detroit, Mich. Catalogue 40,

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listed on pages 130-132 (without charge or obligation), mark with X in the squares below, the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

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devoted to carbide-tipped reamers, lathe centers, and standard carbide blanks, bits, and tools. 31

Vertical Drilling and Boring Machine

JACKSON MACHINE & TOOL CO., Jackson, Mich. Circular describing high-speed precision vertical drilling and boring machines. 32

Small Tools

FORSBERG MFG. CO., Bridgeport, Conn. Catalogue 40, covering the complete line of Forsberg Whale and Viking tools, including hacksaws, screwdrivers, hand drills, etc. 33

Gear-Finishing Machine

GEAR PROCESSING, INC., Cleveland, Ohio. Folder on "Incolap" machines for finishing and correcting production gearing from 1/4 inch to 11 inches in diameter. 34

Inconel Carburizing Containers

MICHIGAN STEEL CASTING CO., St. Aubin Ave., Detroit, Mich. Circular telling why Inconel carburizing boxes and pots increase furnace efficiency and reduce costs. 35

Variable-Speed Pulleys

SPEEDMASTER CO., 1301 Washington Ave., S., Minneapolis, Minn. Data Sheet giving complete information on Speedmaster variable-speed pulleys. 36

Flexible Shaft Equipment

MALL TOOL CO., 7740 S. Chicago Ave., Chicago, Ill. Circular on portable flexible shaft machines for polishing, sanding, buffing, drilling, grinding, and wire-brushing. 37

Electrical Connector Guide

BURNDY ENGINEERING CO., INC., 459 E. 133rd St., New York City. Series of charts designed to facilitate the selection of the proper electrical connector for a given condition. 38

Brazing Alloys

HANDY & HARMAN, 82 Fulton St., New York City. Circular describing the properties and advantages of two low-temperature silver brazing alloys known as Sil-Fos and Easy-Flo. 39

Welding Electrodes

METAL & THERMIT CORPORATION, 120 Broadway, New York City. Catalogue on "Murex" heavy-coated electrodes for arc welding. 40

High-Speed Steels

JESSOP STEEL CO., 605 Green St., Washington, Pa. Circular on Jessop high-speed steels, including instructions for heat-treating. 41

Micrometers

GEORGE SCHERR CO., INC., 128 Lafayette St., New York City. Circular describing the features of construction of Reed micrometers. 42

Gages

PRATT & WHITNEY DIVISION NILES-BEMENT-POND CO., West Hartford, Conn. Circular 449, describing "Pilot" cylindrical plug gages and their application. 43

Forging Hammers

ERIE FOUNDRY CO., Erie, Pa. Bulletin 335, illustrating and describing Erie single-frame forging hammers, built in self-contained and standard types. 44

Drafting Machines and Drawing Tables

DRAFTO CO., Cochranton, Pa. Folder describing "Drafto" portable drawing machines and drawing tables. 45

Hydraulic Grinding Machines

LANDIS TOOL CO., Waynesboro, Pa. Circular illustrating and describing the Landis 4-inch, Type H, plain hydraulic grinder. 46

Ball and Roller Bearings

GWILLIAM CO., 360 Furman St., Brooklyn, N. Y. Catalogue 17, describing the complete line of Gwilliam ball and roller bearings. 47

Wire Rope Connectors

ELECTROLINE CO., 4121 S. LaSalle St., Chicago, Ill. Bulletin F-2, entitled "Positive Grip Electroline-Fiege Wire Rope Connectors." 48

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 133-149 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment mark with X in the

squares below, the identifying number found at the end of each description on pages 133-149 — or write directly to the manufacturer, mentioning machine as described in August MACHINERY.

51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76
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To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 128-129, mark with X in the squares below, the identifying number found

at end of each description on pages 128-129 — or write directly to the manufacturer, mentioning name of material as described in August MACHINERY.

201	202	203	204	205	206	207
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Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Clearing 500-Ton Hydraulic Press

The Clearing Machine Corporation, 6499 W. 65th St., Chicago, Ill., was asked by the Tokheim Oil Tank and Pump Co., Fort Wayne, Ind., to bid on a 500-ton hydraulic press that would combine the recognized flexibility of hydraulic presses with the accuracy of mechanically operated units. The specifications were exacting in so far as accuracy was concerned.

The finished machine was required to undergo a test whereby the full pressure capacity of 500 tons could be applied to a 20- by 20-inch block, placed centrally under the slide, without showing more than 0.005 inch deflection. The second test was to place the block in the "quarter position," that is, one-quarter of the way out from the frame at either side and apply one-half the maximum pressure, or 250 tons. When it is considered that the press has a span of 110 inches between side members of the frame and 60 inches front to back, it is evident that the requirements to be fulfilled were very severe.

The frame members, slide, etc., are of welded steel construction. To avoid more than the allowable deflection under the tests, an extended slide, located above the main slide, was built integral with the latter member. Obviously, this auxiliary slide has a longer leverage to resist tilting under an unbalanced load.

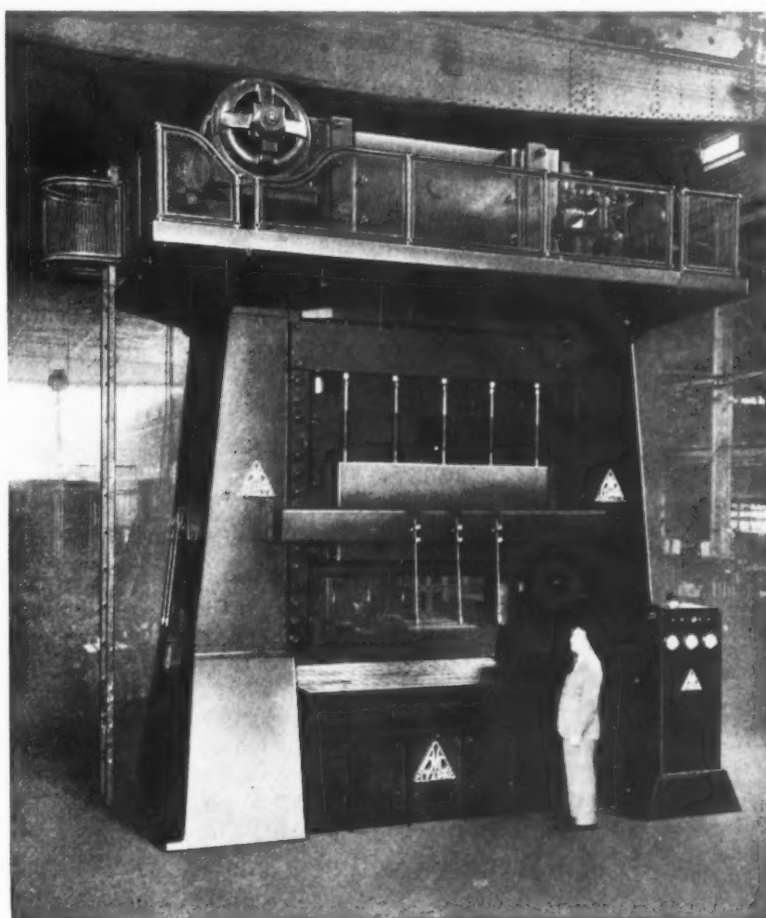
The crown is held to the base of the machine by four tie-rods passing through the side members of the frame. These tie-rods are pre-loaded to 750 tons, thus affording an ample margin over the full capacity of the press. The side members were designed to hold well within the allowable limits of deflection, and when the whole press was assembled, it fulfilled the exacting requirements called for with entire satisfaction.

Pumps with uni-directional flow using valves to reverse the direction in which pressure is applied are em-

ployed to lessen the chances of resultant stresses and vibrations damaging the pump. As a further safeguard, two pumps are employed. One is driven by a 75-H.P. motor and the other by a 5-H.P. motor. Suitable valves for the large pump control the slide of the press through its cycle of movements. When the press is being operated with a high-pressure dwell at the bottom of the stroke, the small pump provides the holding pressure for any desired time. During this dwell period, no

work is accomplished and the pump energy is converted into heat. If the larger pump driven by the 75-H.P. motor were utilized for this purpose, fifteen times as much heat would be developed, and this would be detrimental to the hydraulic system. Provision is made for running the press on an interrupted cycle, as explained, or the cycle may be continuous if such operation is better adapted to the work in hand.

There is an oil reservoir at the top of the machine that supplies oil to



Clearing Press of 500-ton Capacity Built to Meet Exacting Accuracy Requirements

To obtain additional information on equipment described on this page, see lower part of page 132.

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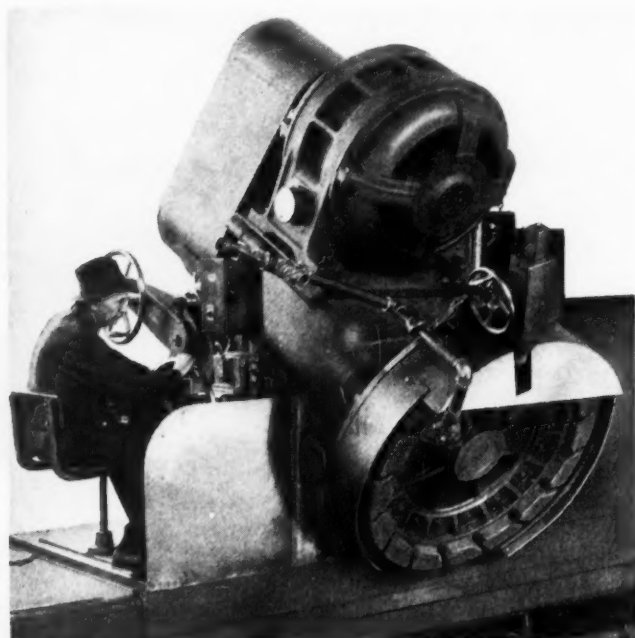


Fig. 1. Hanchett No. 700 Traveling-wheel Grinder for Finishing Armor Plate

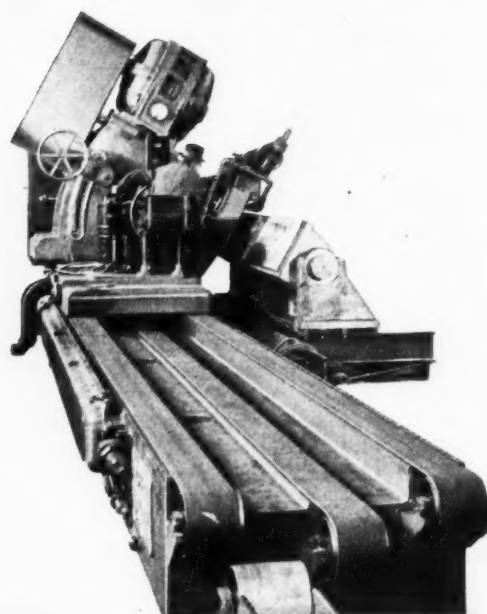


Fig. 2. Grinder Shown in Fig. 1 Equipped for Performing Experimental Grinding Operation

four cylinders inside the welded steel slide. In operation, the slide descends rapidly while all four cylinders are being filled with oil from the reservoir until the upper die carried by the slide encounters the work on the lower die. As soon as work resistance is encountered, the large pump starts delivering oil to the two outside cylinders, and filling of the two inner cylinders from the reservoir continues by gravity. When the pressure builds up to 175 tons in the outer cylinders, an automatic control connects all four cylinders to the pump, thus providing for building up pressure to a maximum of 500 tons. A noteworthy feature of the design provides for the application of any required maximum pressure. Thus, if the pressure does not exceed 175 tons, the two central cylinders take no part in the operation.

To insure safe operation and prevent the possibility of damaging the machine by pressure being built up

below the maximum stroke of the ram, an automatic and positive means is provided for exhausting the cylinders when the rams reach the low limit of their stroke. Consequently, the customary safety blocks to prevent the rams from dropping out of the cylinders or stripping the pull-back cylinder heads are not required.

This machine is adaptable for a wide range of forming operations, from high-production stamping to deep drawing and plastic molding. For production blanking, trimming, and embossing, the design provides for applying a short high-speed stroke. For the performance of deep drawing and similar operations, large hydro-pneumatic die cushions are housed in the bed of the press. For plastic molding, the pressure and dwell at the bottom of the stroke are infinitely variable, and any pressure up to the maximum can be held for an indefinite period. 51

V-belts from a 125-H.P. motor. The grinding-wheel head has hand, power, and automatic cross-feed, and can be adjusted from the vertical position to an angle of 30 degrees. The grinding-wheel carriage travels on one V-way and one flat way, each 6 1/2 inches wide. It is driven by a bull gear which engages a rack attached to the machine bed. This feed mechanism is actuated by a 15-H.P. reversing motor with controls for providing variable speeds. The operator rides on the carriage, and has all controls within his reach.

The ways and rack are protected by belt covers. The ways are lubricated by a force-feed system, including an oil reservoir, filter, pressure gage, pump, and 1/4-H.P. motor. The machine is adapted for wet grinding, a 1-H.P. centrifugal coolant pump being attached to a bracket on the carriage. This coolant pump travels along a channel-shaped tank and delivers coolant both to the wheel and to the work. 52

Hanchett Traveling-Wheel Grinder for Grinding Edges of Armor Plate

A traveling-wheel type grinder in which the work remains stationary while the grinding-wheel head mounted on a carriage travels back and forth along the edge of the plates to be ground is a new product of the Hanchett Mfg. Co., Big Rapids, Mich. This machine has a capacity for grinding plates up to 20 inches thick by 10 feet wide by 45 feet long. The work-table, constructed by the cus-

tomor from concrete, I-beams, plates, etc., is not shown in Figs. 1 and 2. The complete machine, without the work-table, weighs 75,000 pounds.

The grinding wheel is of the segmental type, 48 inches in diameter. Each abrasive block has a grinding face 8 by 4 inches. The grinding-wheel spindle is 8 inches in diameter, mounted in Timken tapered bearings, and is driven through sheaves and

"Fabco" Power Belting

A general-purpose power transmission belt of multiple thin-ply construction, known as "Fabco," has been placed on the market by Fabreeca Products Co., 222 Summer St., Boston, Mass. This multiple thin-ply construction is said to give extremely high flexing ability that will withstand more successfully the distortion encountered when the belt passes around the pulleys. 53

Two-Spindle "Red Ring" Profiling Machine

A two-spindle "Red Ring" profiling machine adapted for milling either internal or external, flat, or under-cut profiles on parts having a contour pattern not larger than 6 by 8 by 2 inches thick, where the cut is 1/8 inch deep or less on a face 3/4 inch wide or less, has been brought out by the National Broach & Machine Co., 5600 St. Jean, Detroit, Mich. The machine is designed for very rapid operation, is entirely automatic, and will hold finished work to a tolerance of 0.002 inch. It is stopped automatically at the end of the cutting cycle; and as it is only necessary to load and unload the two fixtures, one operator can handle more than one machine.

The principal field of application for this machine is in the manufacture of parts for small arms and artillery breech mechanisms; the duplication of all kinds of flat cams; the profiling of airplane pistons and connecting-rods to reduce weight; the production of instrument parts, accurate machine elements, and electrical equipment parts.

It utilizes a differential hydraulic circuit to actuate its movements. The work-table moves laterally, and the spindle head moves at right angles to the direction of the table movement. These two principal move-

ments are both reversible, and each is actuated by its own hydraulic cylinder. When the spindle-head cylinder is working under feeding pressure, the table cylinder works under holding pressure, and vice versa. The change from feeding pressure to holding pressure is obtained by means of dogs which operate limit switches.

A master pattern or cam the exact size and shape of the finished work is mounted on the bottom of the work-table. A guide pin integral with the spindle head extends upward from under the table to contact the periphery of the master cam. The location of this mechanism beneath

the table serves to eliminate errors through the accumulation of chips and dirt. The guide pin travels around the periphery of the master cam, its motion being guided by the cam. The guide pin is kept in contact with the cam by hydraulic pressure, which changes from feeding to holding pressure from point to point along its path as required by the shape of the pattern being machined.

The cutter-spindles are driven by individual motors. Vertical adjustment is provided on the spindles to allow for slight variations in tool adjustment. The tapered guide pin is adjusted vertically by a graduated dial to compensate for cutter wear. The work-table accommodates large work-holding fixtures. 54

Spot-Welders of Standardized Design

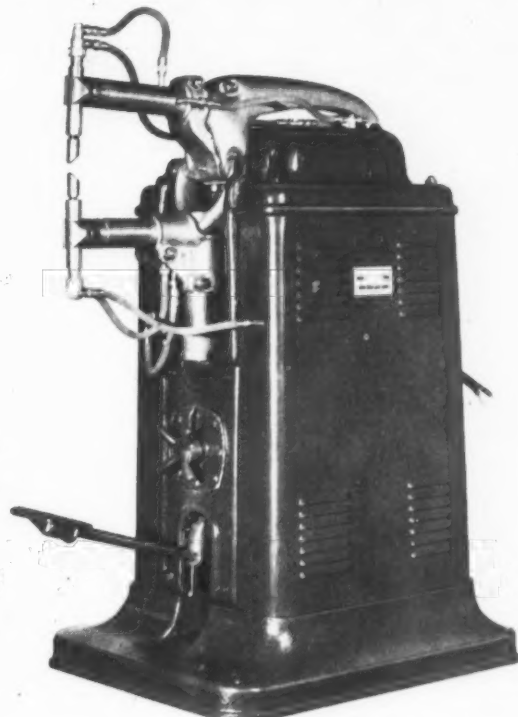
A line of standardized spot-welding machines designed to permit welders formerly classed as special to be assembled quickly and at comparatively low cost has been brought out by the American Electric Fusion Corporation, 2610-2622 Diversey Ave., Chicago, Ill. Spot-welding machines designed to meet a wide range of applications can be manufactured on a mass-production basis from three standardized sizes of frames, all of which have the same character-

istics of design and interchangeable parts wherever possible.

Each of the three frame sizes will house either of two transformers. The BG type welder with a 10-KVA capacity will also house the 15-KVA transformer of the BH type. The medium-frame size will take either the 20-KVA transformer of the BL type or the 30-KVA transformer of the BM type. The large-frame machine will take either a 40- or a 50-KVA capacity transformer of the



"Red Ring" Profiling Machine Equipped with Two Spindles



Spot-welder Built by the American Electric Fusion Corporation

To obtain additional information on equipment described on this page, see lower part of page 132.

BP or the BR type. Thus, with only three frame sizes a standardized line of spot-welders ranging in ca-

capacity from 10 to 50 KVA can be readily assembled to suit a wide range of work. 55

Combination Wheelabrator "Tumblast-Tablast" Metal-Cleaning Equipment

The American Foundry Equipment Co., 399 S. Byrkit St., Mishawaka, Ind., has brought out a line of metal-cleaning machines for handling work that requires both tumbling and abrasive-blast cleaning. The new Wheelabrator is intended for the jobbing foundry having a varied production which requires both a tumbling type and a table type machine. By combining a Wheelabrator 6-foot plain Tablast and a 27- by 36-inch Wheelabrator Tumblast into one unit, a machine is produced that effectively employs the cleaning economies of both machines.

The 27- by 36-inch Wheelabrator Tumblast is a light-duty machine adapted for cleaning small castings, forgings, and other metal parts. The Wheelabrator 6-foot plain Tablast is designed for cleaning flat fragile or thin-section castings, being particularly adapted for use in gray-iron shops which produce castings such as used in the stove and furnace trade.

The Tumblast unit uses an endless apron conveyor which completely exposes all surfaces of every piece to the full effect of the abrasive blast. In the Tablast unit, the work is cleaned by being carried on a single rubber-covered table under the abrasive blast produced by an airless Wheelabrator unit. The Wheelabrator

unit provides a simple mechanical means of abrasive blasting. In the Wheelabrator process, abrasive from an overhead storage hopper is fed by gravity through a chute and control cage to the center of the patented Wheelabrator wheel which rotates at high speed. The abrasive is thrown from a wheel upon the product being cleaned by the centrifugal force developed by the rotating wheel.

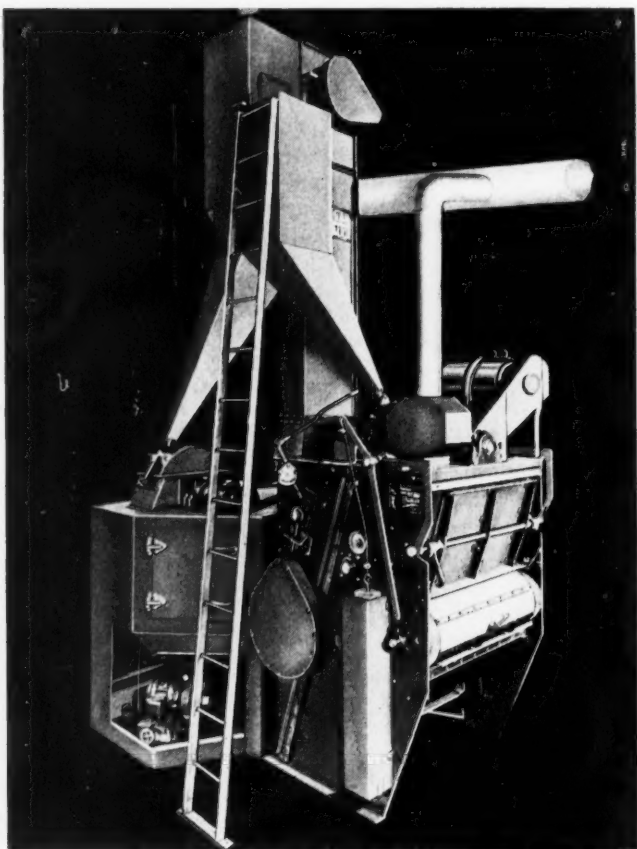
The different units combined in the new equipment described are made in various styles and sizes to suit different requirements and for use as separate units. 56

Kent-Owens Double-Spindle Milling Machines

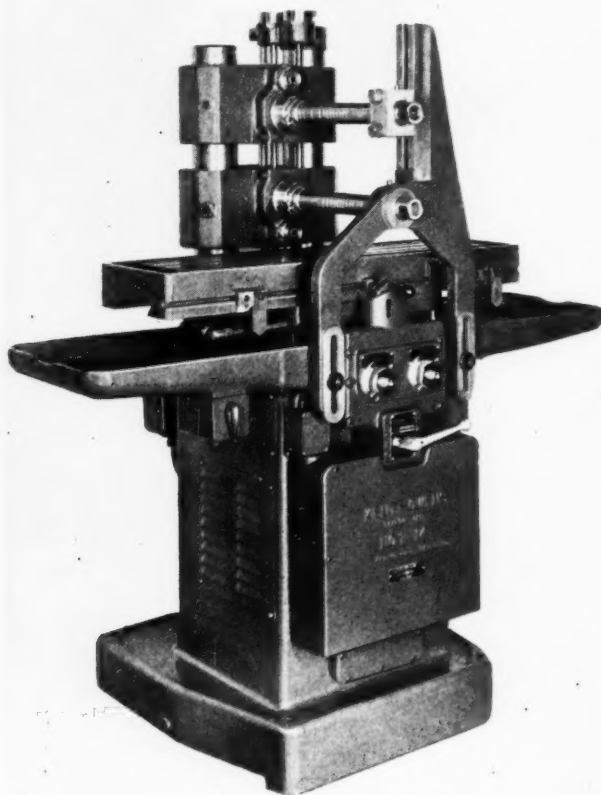
The Kent-Owens Machine Co., Toledo, Ohio, has brought out a new line of milling machines equipped with double spindles. These machines are especially suited for splitting bushings and milling slots in pistons. They can also be used to advantage on a wide variety of other parts where two or more surfaces spaced some distance from each other can be milled by using two cutters mounted on different spindles.

The illustration shows double spin-

dles mounted on a Kent-Owens No. 1-14 hydraulic milling machine. The table of this machine is 32 by 9 inches and has a travel of 14 inches. Two panel dials control the feed rate of the table through a range of from 1/2 inch to 80 inches per minute, the dial at the left being used for the fine feeds and that at the right for the coarse feeds. The spindles are adjustable vertically and independently of each other by means of screws having micrometer dials. The



Combination Tumbling and Sand-blasting
Metal-cleaning Machine



Double-spindle Milling Machine Developed by
Kent-Owens Machine Co.

center distance between the two spindles can be adjusted from 4 3/4 to 11 inches. The center of the lower spindle can be brought to within 1 inch of the table surface, and the center of the upper spindle can be raised to a maximum of 12 inches from the table surface.

Each of the spindles has a horizontal adjustment of 1 1/2 inches independently of the other, and can be accurately positioned by means of micrometer dials. The machine is furnished complete with spindle drive motor, hydraulic pump motor, and electrical equipment. 57

Moline Boring Machine

A single-spindle boring machine—the No. HF-145—has been added to the line of the Moline Tool Co., Moline, Ill. In some respects, this new machine resembles a jig borer, an outstanding feature being a hydraulically operated table and spindle carriage. The boring spindle is mounted in heavy roller bearings, and is driven through a set of quick-change gears which can be adjusted for four different spindle speeds by a hand-lever. These spindle driving gears are self-lubricated from an oil reservoir in the driving head. The hydraulic feed of the boring spindle can be set for an automatic operating cycle or it can be controlled by a hand-lever.

The work-table is operated by hydraulic pressure at either the rapid traverse or feed rate, toward or away from the machine column and to the

right or left. The machine illustrated is equipped with a round "rotatable" table which can be set on the rectangular work-table when required.

The hand-lever that controls the vertical travel of the boring spindle carriage is used also to control the motions of the table. Only one of these three motions—the spindle travel, the in-and-out travel of the table, and the cross-travel of the table—can be operative at one time, due to mechanical interlocking of the

valves in the hydraulic circuit. A three-position selector lever is provided which is set to determine which of the three motion-producing hydraulic cylinders will be connected to the hydraulic feed unit.

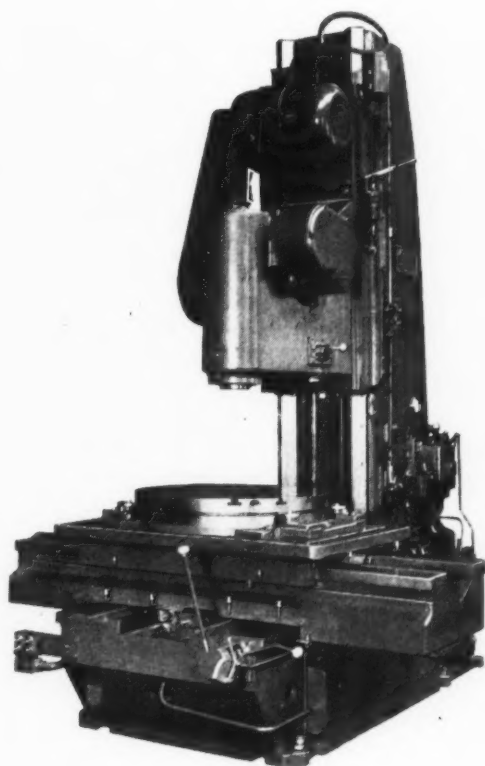
The feed travel for any of the hydraulic motions can be varied from zero to the maximum rate at any time from the operator's position by manipulation of a lever which is linked to the volume-control lever of the hydraulic unit. This lever connection facilitates accurate setting of the table.

The general specifications of the machine are as follows: Boring spindle is provided with a No. 7 Morse taper; spindle speeds, 26, 37, 55, and 84 R.P.M.; vertical travel of spindle carriage, 36 inches; travel of table to and from the column, 20 inches; cross-travel of table, 40 inches; and distance from floor to surface of rectangular table, 36 inches. 58

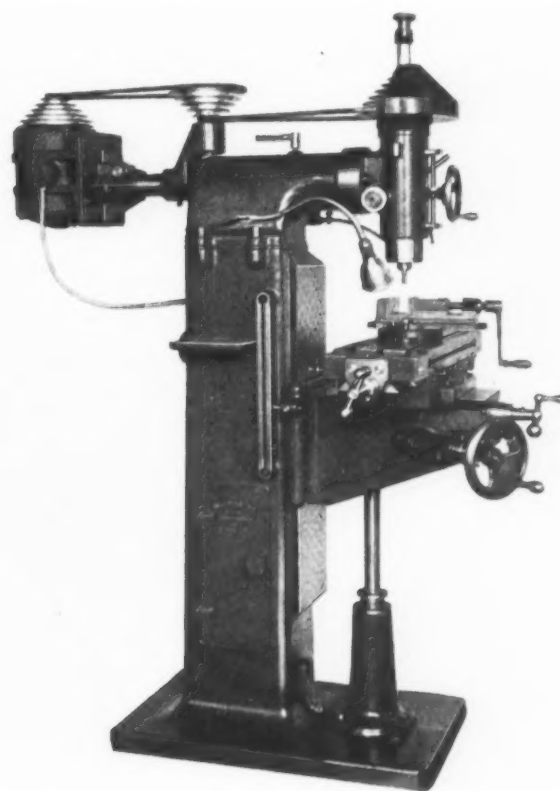
"Millmaster" Vertical Milling Machines

A high-speed, precision, vertical milling machine designed for performing such operations as boring, milling, routing, drilling, grinding, and die-sinking has been brought out by the Midway Machine Co., 2324

University Ave., St. Paul, Minn., in a stationary quill model and a movable quill model. The base of this machine is 22 inches wide and 34 inches long. The distance from the column to the center of the spindle



Moline Boring Machine with Hydraulically Operated Table and Spindle Carriage



"Millmaster" High-speed Vertical Milling Machine
Built by the Midway Machine Co.

is 10 1/2 inches. The table is 9 inches wide by 34 inches long, and has a maximum vertical feed of 30 inches and a maximum longitudinal feed of 18 inches. The maximum transverse table feed is 10 inches.

The spindle of this machine will take a No. 9 B & S taper shank, has a maximum draw-in collet capacity of 3/4 inch, and a capacity for holding end-mills from 1/8 inch to 3 inches. An outstanding feature is the swiveling spindle which can be

adjusted through an angle of 180 degrees. Seventeen spindle speeds ranging from 275 to 4300 R.P.M., are obtained with two pulleys, and forty-four speeds ranging from 70 to 10,000 R.P.M. with the center or third pulley.

The movable quill has a vertical travel of 5 1/2 inches and is operated by a fast lever feed and a slow worm drive with handwheel. Micrometer adjustment and a hand-lock lever are provided. 59

"Progress-O-Matic" High-Speed Spot-Welder

A new "Progress-O-Matic" high-speed spot-welder capable of making more than 6000 spot-welds an hour has been developed by the Progressive Welder Co., 3024 E. Outer Drive, Detroit, Mich. One of the first production machines of this new line is now in operation on 1941 model automobile body work. An entirely new method of transferring current makes and breaks the secondary, as well as the primary circuits, and gives the machine such flexibility of operation that it can weld an assembly having several thicknesses of metal.

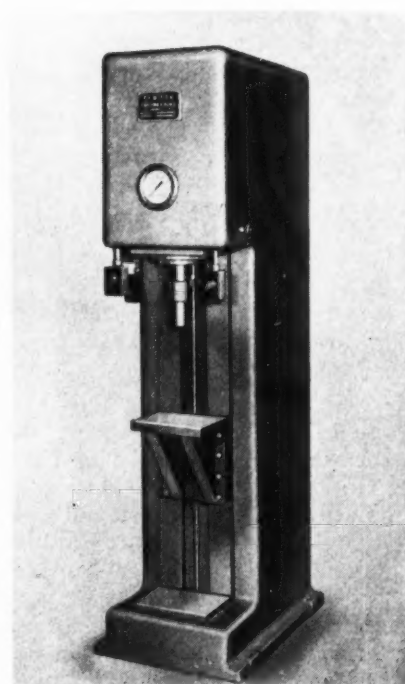
All welding points are brought down on the work under full pressure and held there throughout the entire welding cycle. Since the points are already on the work before the current is on, and remain there after the current is off, the chance of burned welds is practically eliminated. A longer cooling time, with work under pressure between contacts, further assists in improving the weld characteristics.

The lower electrodes of the welder shown in the illustration can be interchanged quickly to accommodate

assemblies of different sizes. This particular machine makes thirty-six spot-welds in joining the halves of two sizes of automobile hood tops. Pressure on the control button causes the work to be raised to the welding position by means of four air cylinders. Additional air cylinders then function automatically to exert the desired predetermined pressure at all welding points. When the welding cycle is completed, the table returns to the open position and the work is unloaded. The secret of rapid operation is the built-in timing mechanism consisting of a 1/4-H.P. air motor which drives an indexing disk for timing the flow of current to the welding guns. Only one complete revolution of the timing disk is required in making all thirty-six spot-welds. 60

Denison Knee Type Hydraulic Press

A new knee type hydraulic press has been brought out in 5- and 15-ton capacities by the Denison Engineering Co., Chestnut and Water Sts.,

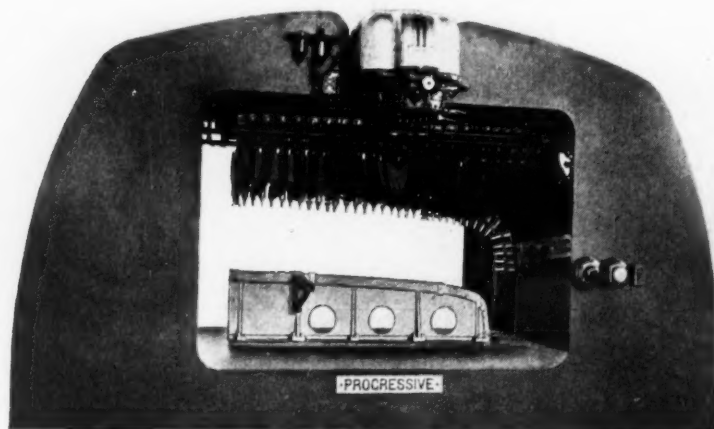


Knee Type Hydraulic Press Built by Denison Engineering Co.

Columbus, Ohio, to meet the demand for machines of these sizes. This versatile press is especially adapted for assembling, straightening, and other general-production pressing operations. It is arranged to permit rapid change of tools and fixtures as required for either short-run or production work. This Type DLKC2 hydraulic press has a finished lower platen and throat surface to accommodate a variety of bolsters, supports, or special tools and fixtures.

The general arrangement of the press is as follows: The control valve and its operating mechanism, motor, and pump are located in the center section. The ram and cylinder assembly is located in the upper part of the frame, and the oil reservoir is in the base. To operate, the control lever is pushed down. This causes the ram to descend until it either comes in contact with the work or reaches the limit of the down stroke. If it comes in contact with the work before the lower limit of the stroke is reached, pressure will continue to be exerted against the work until the controls are released. When the ram reaches the limit of the up stroke, it stops, the pressure is released, and the pump and motor run idle. The stroke and pressure can be easily adjusted.

This press is available with either manual or electrical controls. The electrical controls, however, offer the maximum in speed and safety. The two operating push-buttons are so arranged that both buttons must be



"Progress-O-Matic" Welder Capable of Making More than 6000 Spot-welds an Hour

depressed simultaneously, thus safeguarding the operator's hands. As an additional safety measure, a transformer is used to reduce the push-button current to 110 volts. If desired, push-buttons requiring only

one hand for operation can be furnished. The manually controlled press is furnished with either a hand-lever or a foot-pedal, or the machine can be furnished with both controls if desired. 61

Brown & Sharpe End-Mill Grinding Attachments

The Brown & Sharpe Mfg. Co., Providence, R. I., has recently added to its line of equipment two new end-mill grinding attachments designed for use on the B & S No. 10 cutter and tool grinding machine and the B & S No. 13 universal and tool grinding machine.

The attachment designed for use on the No. 10 machine is especially adapted for sharpening the peripheral teeth of steep spiral end-mills having straight or taper shanks. A knob at the rear end of the attachment spindle facilitates holding the tooth being ground in contact with the tooth-rest while the cutter is being fed across the wheel by a longitudinal movement of the table. Anti-friction spindle bearings provide a sensitive free-turning unit which is an advantage when sharpening very small end-mills having a steep spiral.

The attachment spindle is carried in a body which is supported by and turns horizontally on a base casting, as shown in Fig. 1. Two zero lines 180 degrees apart assure proper alignment of the spindle with the table of the machine when sharpening either right- or left-hand cutters, the base itself being aligned by keys which fit the table T-slot.

End-mills having a No. 9 B & S taper shank will fit directly into the attachment spindle, while cutters having other B & S tapers, as well

as cutters with milling machine standard taper shanks and straight shanks, are accommodated by stock collets and adapters available as extra equipment. A draw-in bolt can be furnished for use with spring collets for holding straight-shank end-mills.

The attachment designed for use on the No. 13 universal and tool grinding machine is also particularly adapted for sharpening the peripheral teeth of deep spiral end-mills having straight or taper shanks. This attachment, as shown in Fig. 2, is identical in operation to the No. 10 attachment. 62

Grob Metal Band Saw

Grob Brothers, Grafton, Wis., have developed a Model NS-18 band saw of improved design with an 18-inch throat, which is intended for tool-room, as well as general machine shop, use. It has a reinforced one-piece welded steel frame and swinging doors that provide quick access for changing the saw blades. The heavily ribbed cast-iron table is 24 by 24 inches, and can be tilted in four directions. Besides being clamped in the conventional manner, the table is locked with a stabilizer to prevent movement under the heaviest working pressures.

A butt welder with built-in tool



Grob Metal Band Saw with 18-inch Throat

grinder is mounted in the frame for use in joining saw blades for internal cutting operations. Both the upper and lower saw guides are adjustable for height, and their holders are locked in position by a single-lever, quick-acting clamp.

There is a drawer and cabinet for storing tools, saw blades, etc. A 1-H.P. motor is used in connection with a silent V-belt drive. All pulleys are mounted in ball bearings. Ten speeds are provided which range from 50 to more than 2000 feet per minute.

This saw will handle the smallest, most intricate work with blades as small as 1/16 inch by 0.025 inch; yet the large throat depth of 18 inches and the distance of 12 inches from the table to the upper column enable the machine to cut extra heavy work with saw blades up to 1 inch in width. The machine weighs approximately 1000 pounds, and requires a floor space of about 33 by 41 inches. 63

New Series Timken Bearings

The Timken Roller Bearing Co., Canton, Ohio, is placing on the market a new bearing series of the standard SS type. These bearings have steep cup and cone angles, and are designed primarily for use where thrust loads are large, compared to radial loads. The first bearing in this series is 9285-9220, with a cone

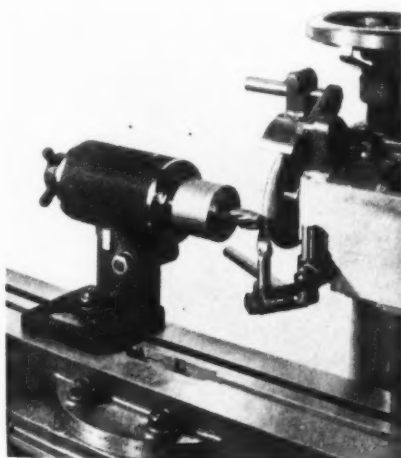


Fig. 1. Brown & Sharpe No. 10 End-mill Grinding Attachment

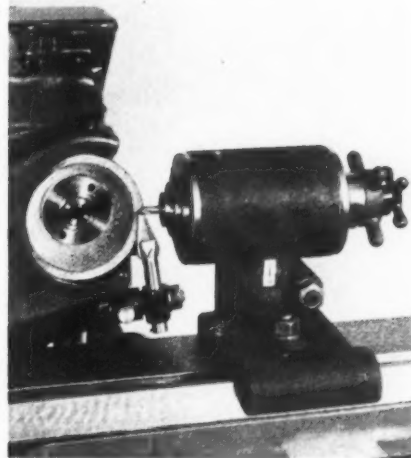


Fig. 2. Brown & Sharpe No. 13 End-mill Grinding Attachment

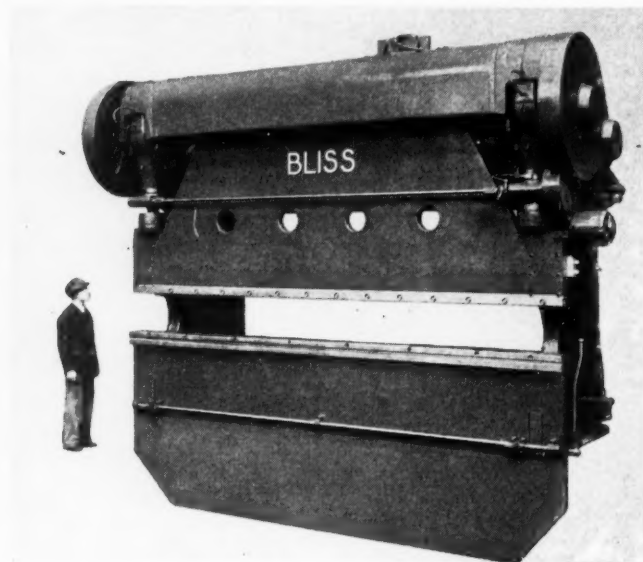
bore of 3 inches, an outside diameter of 6 3/8 inches, and a width of 1 15/16 inches. At 500 R.P.M., this bearing has a radial capacity of 6255 pounds and a thrust capacity of 8710 pounds.

The 9100, 9300, and 90,000 series bearings of the SS type have also been redesigned to reduce the outside diameters and widths of each series while maintaining the same load-carrying capacities. Two cone bores of 2 7/16 and 2 11/16 inches are available in the 9100 series; two different bores of 3 and 3 5/16 inches are available in the 9300 series; and one cone bore of 3 13/16 inches is available in the 90,000 series. 64

Bliss Press Brake

Versatility is an outstanding feature of the latest addition to the line of all-steel press brakes built by the E. W. Bliss Co., 53rd St. and Second Ave., Brooklyn, N. Y. The new press is equipped to handle a wide range of work within a bending capacity of 1/4 inch by 12 feet in mild steel. An electrically operated friction clutch and V-belt motor drive are employed on this machine.

The intermediate gearing is lubricated by oil or grease in oil-tight housings. The specifications are: Distance between housings, 12 feet 6 inches; depth of gap, 12 inches; stroke of slide, 3 inches; adjustment of slide by motor, 6 inches; distance from bed to slide with stroke down and adjustment up, 12 inches; and maximum operating speed, 30 strokes per minute. 65



Bliss Press Brake Built to Handle a Wide Range of Work



Max Floor Model Disk Sander with Adjustable Table

Max Disk Sander

A universal, floor model, 16-inch disk sander with direct motor drive has been placed on the market by the Max Mfg. Co., 735 The Alameda, San Jose, Calif. This sander is adapted for surfacing metal, wood, plastics, and various other materials. The working unit is mounted on top of a ground steel column which is pressed into a cast-iron base.

The table is raised or lowered to any desired height through a worm-gear mechanism. It measures 9 1/2

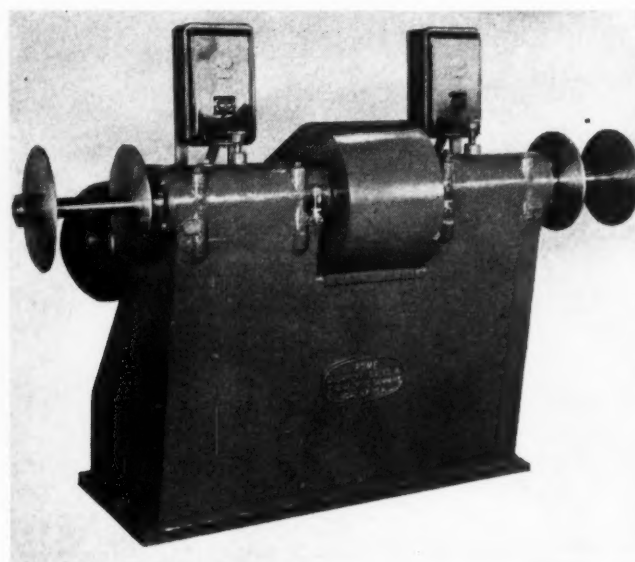
by 18 inches, and is provided with trunnions and locks at each end. The table can be quickly set to a large protractor and locked at any angle from 45 degrees above to 45 degrees below the horizontal position. A 3/8- by 3/4-inch groove milled in the table accommodates any standard angle-gage, thus providing for any combination of angles.

The 16-inch disk is machined all over and carefully balanced. It is attached to a large flange on the motor-shaft by three studs, leaving the working face free from holes. This sander is equipped with a 1/2-H.P. ball-bearing motor. It is also available in a bench model. 66

Rome Heavy-Duty Double-Spindle Polishing and Buffing Lathe

A new two-motor, double-spindle, polishing and buffing lathe that is especially adapted for the new slow-speed loose-abrasive method of finishing has been placed on the market by the Rome Machinery Sales & Engineering Co., 627-35 Webster St., Rome, N. Y. This lathe can be arranged for heavy-duty, automobile-bumper rail polishing and buffing. It can be equipped with long, overhanging, wheel-spindle housings for agricultural implement processing and similar work.

The machine illustrated is equipped with two 10-H.P., totally enclosed, fan-cooled, ball-bearing motors, and push-button controlled magnetic starting switches, but these machines can be equipped with motors of



Rome Polishing and Buffing Lathe with Overhanging Spindle Housing

various sizes up to 25 H.P. The spindles will carry 18- to 36-inch diameter 8-inch face wheels, with 2-inch arbor holes. Wheel dust hoods of any design can be furnished to specifications, complete with mounting brackets. The weight of this machine is about 3100 pounds. 67

Atkins Curled-Chip System of Metal Cutting

A new line of power metal-cutting saws identified as a group under the general term Atkins "Curled-Chip System of Metal Cutting," has been developed by E. C. Atkins & Co., 402 S. Illinois St., Indianapolis, Ind. This new line includes saws of all types for cutting any commercially machinable material. The distinguishing feature of these power saws, which is primarily responsible for their improved performance, is the new tooth design. The teeth are formed with an inward-curved cutting edge which produces a curled, clock-spring like chip from which the trade name of the saws is taken.

Like a well ground lathe tool, the cutting edge of the tooth bites into the material to be cut at a slight angle, lifting the chip and causing it to roll as a single piece within the curved contour of the tooth gullet. When the tooth reaches the end of the kerf, the curled chip leaps free like a suddenly released clock spring. No broken chips are carried through the cut a second time to become jammed in the gullet or retard the clean cutting action. This self-cleaning action makes it possible to employ heavier feeds and faster cutting speeds. 68



Fig. 1. Entering "Pilot" Gage in Hole Only 0.0001 Inch Larger than Gage



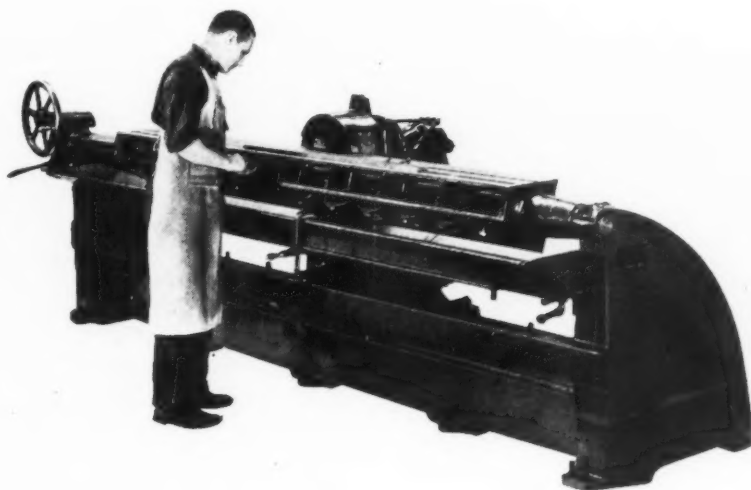
Fig. 2. Pratt & Whitney "Pilot" Cylindrical Plug Gage in Gaging Position

Pratt & Whitney "Pilot" Cylindrical Plug Gages

Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford, Conn., can now supply any of its regular or special cylindrical plug gages, including the chromium-plated plug gages and TC plugs, with the "Pilot" feature at a very small increase in price. Plug gages with the "Pilot" feature are produced under license from the originators in England, the principle being patented under U. S. Letters Patent No. 2,199,052. While it is possible

for anyone to convert existing plug gages into "Pilot" plugs, such an alteration is a violation of the patent. Pratt & Whitney is prepared to alter existing gages or to supply new ones, as needed.

The "Pilot" principle has been developed to facilitate entering the gage in the hole. The combination of a chamfer at the end and an annular groove near the end permits easy entry, and the gage centralizes itself, lines up, and enters without jamming. Even when the plug is a very close fit, it slides into the hole without difficulty. These gages can be used by unskilled operators. 69



Seybold Knife-grinding Machine with Automatic Feed for Grinding Wheel, and Pump Cooling System

Seybold Precision Knife-Grinding Machine

A high-speed precision knife grinder with automatic feed for the grinding wheel and a centrifugal pump cooling system has been brought out by the Seybold Division, Harris-Seybold-Potter Co., Dayton, Ohio. This grinder is designed to produce, as quickly as possible and with the removal of a minimum amount of metal, a keen true cutting edge that requires little honing. It will grind shear blades or bevel knives and almost all types of straight knives in general use.

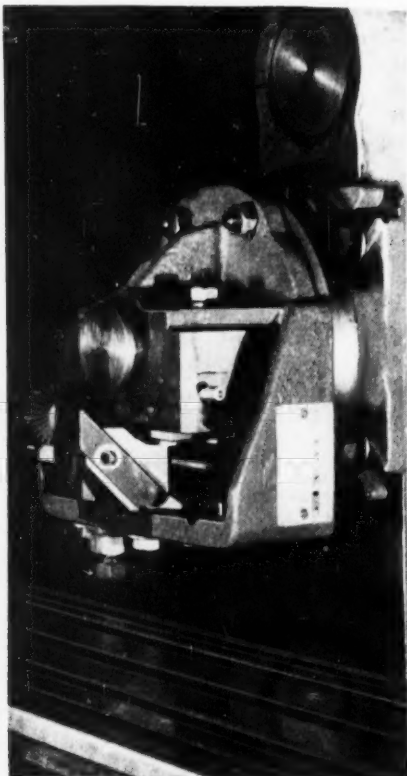
A hollow three-sided knife bar with each surface presenting a different series of angles to the action

of the traveling grinding wheel is a feature of the grinder. A fourth open side permits various types of blades to be clamped to the bar. A variety of sizes can be accommodated, and blades up to 6 inches in width can be ground. The machine is made in three sizes to accommodate blades 70, 100, and 128 inches in length. It can also be made to order in other sizes. 70

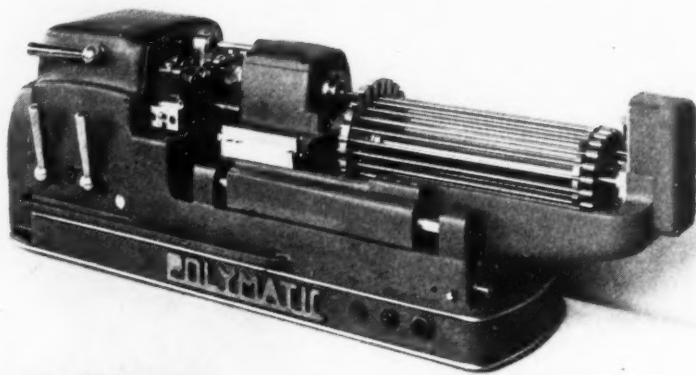
Cherrying Attachment for Milling Machine

A cherrying attachment designed to fit most vertical and horizontal milling machines has been brought out by the Aber Engineering Works, 1613 Flett Ave., Racine, Wis. With this attachment, it is possible to cut sharp corners, channels, under-cuts, hollows, and concave areas of various depths and diameters in dies and odd-shaped pieces. The final 0.015- or 0.020-inch finishing cut can be taken with the cherrying cutter after roughing the work nearly to size with an ordinary end-mill.

The cherrying tool completely finishes the cut, so that, in most cases, no chipping, grinding, filing, or other hand-finishing operations are required. The attachment is graduated 360 degrees around the calibrated scale to facilitate determining work-



Aber Cherrying Attachment Mounted on Horizontal Milling Machine



"Polymatic" High-speed Wire-forming and Cutting-off Machine with Special Attachment

angles. The only part of the attachment requiring lubrication is the worm driving gear, which should be grease-lubricated every three months. The spindle of the attachment fits the standard milling machine spindle. Cutters of different diameters can be readily accommodated, and the cone-pin bearing points can be separated to take cutters of from 1/4 inch to 3 inches in width. Special form cutters for finishing odd-shaped work can also be used. 71

"Polymatic" High-Speed Wire-Forming and Cutting-Off Machine

A high-speed wire-forming and cutting-off machine designated the "Polymatic" has been developed by the Unit Machinery Co., Rockford, Ill., for the production of small precision screw machine parts. This machine will feed stock to a fixed or swinging stop, form and cut off with two cross-slide tools, and perform one or two end operations, such as threading, drilling, box-turning, or turning with a swing type tool and live pick-up spindle.

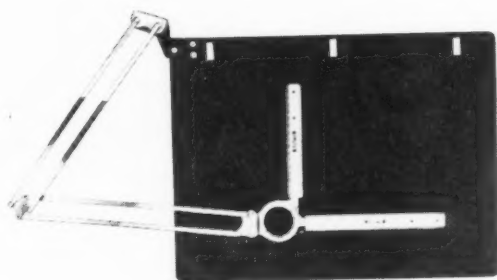
The particular machine illustrated has a special attachment and was built for the Ford Motor Co. The "Polymatic" can be equipped with a live pick-up spindle which is geared to the main spindle. A collet in the spindle nose chucks the part while it is being cut off, and prevents the premature breaking off of the work which results in the formation of burrs. As the collet opens in the pick-up spindle, the part is pushed through a tube inside the spindle. The finished parts drop out at the rear end of the spindle in a clean condition, entirely separated from the chips.

Two models are available. The No. 01 handles wire stock up to 5/32 inch in diameter, while the No. 11 handles stock up to 1/4 inch in diameter. Both sizes are available with either self-contained or a streamline cast-iron base, or they may be had in a bench type model. The machines are motor-driven, with pick-off gears for changing the spindle speed and the feed. The spindle speeds of the smaller model range up to 15,000 R.P.M., and of the larger model, up to 10,000 R.P.M.

The spindle and all other revolving parts are mounted in anti-friction bearings. All moving parts have cascade or drip lubrication, with an oil-circulating system, including a built-in pump. The floor space required for the two sizes, exclusive of the stock tube, is 10 by 30 inches, and 16 by 40 inches. 72

Diamond Wheel-Dressing Tool

The Abrasive Dressing Tool Co., 1550 Broadway, Detroit, Mich., is placing on the market an improved line of diamond wheel-truing tools known as the "Abrasive Red Band" series, which are identified by a brilliant red band on the shank. The "oxide free" process is employed to secure the diamonds in the tool. One of the new tools—the No. 11—contains three rows of diamonds, precisely staggered and spaced to permit the tools to be used for single-stone or cluster type dressing. By regulating the drag-angle, a single stone or three stones can be brought into contact with the wheel. This tool can be used for truing large-radius grinding wheels, surface grinding wheels, wheels employed for medium cylindrical grinding, and all other tool-room dressing operations. 73



Portable Drawing Machine Made by the Drafto Co.

Drafto Drawing Machines

Two new series of portable drawing machines are being built in seven models by the Drafto Co., Cochran, Pa. The first, known as the 30 series, is regularly made in three styles that accommodate drawing paper sheets 12 by 18 inches. One model is complete with 6- and 8-inch detachable scales. Another is of the vertical type, while still another is furnished unmounted—that is, without the Masonite board or paper clamps—but otherwise the same as the types described.

The second series of Drafto machines take drawing paper sheets 15 by 20 inches, and are available in various models. Both series of drafting machines have a protractor made of stainless steel, with all the graduations cut on a special machine. The graduations are very accurate and with the vernier attached to the back-plate, it is possible to set the machine to 1/2 degree. The latching feature makes it possible to set the protractor quickly to the zero point and at angles of 30, 45, 60, and 90 degrees either side of zero. 74

Nielsen Lay-Out Punches

A new method of transferring the lay-outs for screw and stud holes, as well as blind drill holes, from a drilled surface to another surface that is to be drilled in duplicate has been developed by the Nielsen Tool & Die Co., Berkley, Mich., in the form of transfer screw and punch sets. Lay-out punches for the use of toolmakers and diemakers, machinery builders, erectors, and machine repair shops are made to transfer drill holes through a drilled section in diameters of from 17/64 to 59/64 inch. The punch is made with a case-hardened tip that is removable for replacement. When a solid blow is struck on the punch-head, the tip will



Lay-out Punches for Transferring Screw Holes

accurately transfer the drill center and drill circle to the surface to be drilled. The lay-out marks thus produced cannot be lost through the action of the drill or drilling fluids. 75

FabriSteel "Fast-On" Lock-Nut Attaching Machine

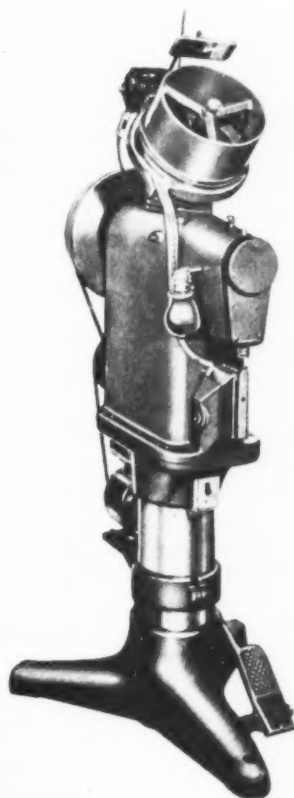
A special machine has been designed by FabriSteel Products, Inc., Kerr Machinery Bldg., Detroit, Mich., for use in setting "Fast-On" lock-nuts of the type described in June MACHINERY, page 164. Machines of this kind are especially adapted for use where large-scale production is required.

The nuts are fed from a continuous rotating hopper to an anvil, where the clutch is tripped and the "Fast-On" nut is locked in place. The machine has a speed of 200 R.P.M. There are no obstructions to interfere with the operator, and it is claimed that 2500 "Fast-On" lock-nuts can easily be set per hour in assembling small parts. As soon as a nut is locked in place, another nut is fed into position. 76

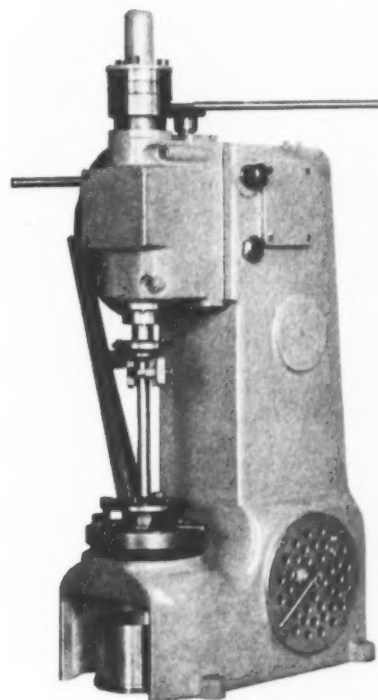
Bench Model "Incolap" for Finishing Small Gears

A new bench model "Incolap" machine has been designed by Gear Processing, Inc., 6700 Grant Ave., Cleveland, Ohio, to meet the demand for a small, light machine adapted for the rapid finishing of small gears. This machine will take gears from 1/4 inch to 2 inches in diameter. It weighs less than 200 pounds, and is 32 inches high.

The model illustrated has manual controls for stopping and starting the machine, for lifting the gear to permit indexing, and for controlling the pressure between the gear and the lap. Provision is also made for automatic control of these motions, using a time-clock mechanism and



Hopper-fed Machine for Setting "Fast-On" Lock-nuts



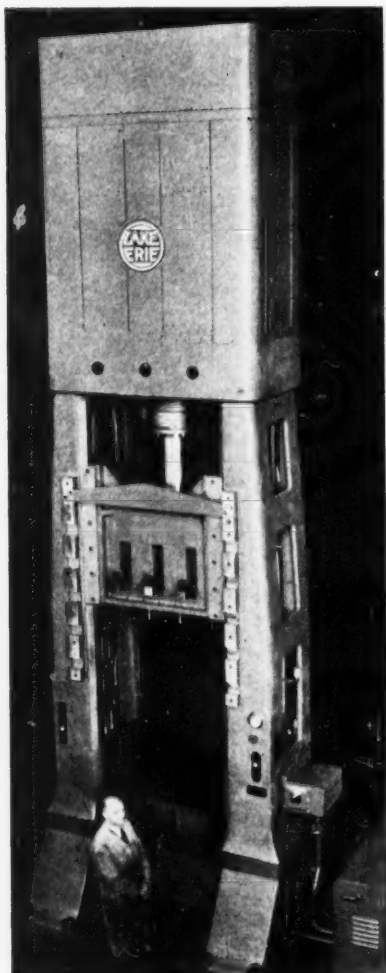
Bench Model "Incolap" for Finishing Gears up to 2 Inches in Diameter

actuating air cylinders such as are employed on the double-spindle "In-colap" machines.

The motion of the gear inside the lap is controlled by a helical guide and nut. An oil gage indicates the amount of oil in the crankcase of the machine. The distance the gear enters the lap is controlled by a calibrated dial. The length of the stroke can be varied from 0 to 1 inch by means of a simple eccentric adjustment on the driving shaft. This adjustment is made on the outside of the flywheel. Power is furnished by a 1/4-H.P. motor operating at a speed of 1800 R.P.M. The maximum speed of the lap is 350 reciprocations per minute. 77

Lake Erie 150-Ton Long-Stroke Hydraulic Press

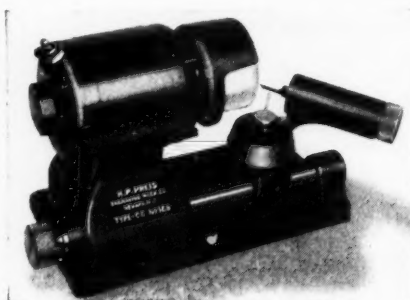
A 150-ton hydraulic press with an unusually long stroke, especially designed for drawing cartridge cases, has just been built by the Lake Erie Engineering Corporation, Buffalo, N. Y. This press has a clear height



Lake Erie Long-stroke Press for Drawing Cartridge Cases

of 108 inches and a stroke of 76 inches. It has a solid housing with gib-guided platen and adjustable knock-out bar that adapts it for various types of work other than that of drawing cartridge cases.

Conveniently located push-buttons control inching, semi-automatic, and fully automatic operation. Adjustable control of the working pressure, as well as of the length of the up and down strokes, contributes the flexibility required to suit various operations and save die-setting time on original and subsequent runs. The top of the press is completely enclosed by removable panels. A high-speed pumping unit insures maximum production with fast approach and return of the platen. 78



Panto Grinder for Single-lip Engraving Cutters

Grinder for Single-Lip Engraving Cutters

A compact bench type grinder designed for the accurate sharpening of single-lip engraving and routing cutters has been brought out by the H. P. Preis Engraving Machine Co., 159-A Summit St., Newark, N. J. This machine, designated the "Panto Model CG," handles tapered-shank cutters and straight-shank cutters up to 1/4 inch in diameter.

The grinding wheel is of the cup type, 2 1/4 inches in diameter, and is attached directly to the shaft of an enclosed ball-bearing universal motor operating at a speed of 8500 R.P.M. The cutter-holding spindle is mounted in a swivel arm which is graduated for quick setting to any cutting angle or taper desired. Stop-notches are provided for grinding three- or four-cornered cutters. While the cutter is rotated by the right hand, the carriage is fed to the grinding wheel by means of a feed-screw actuated by the left hand.

A solid spindle is furnished for tapered-shank cutters only, and a collet spindle is available for tapered- and straight-shank types. 79



B & S Plain Grinding Machine with Automatic Cross-feed

Automatic Cross-Feed for B & S Plain Grinding Machines

Automatic straight-in feed grinding, with the machine table stationary, can be performed on a B & S No. 5 plain grinding machine with the addition of the independent automatic cross-feed arrangement recently brought out by the Brown & Sharpe Mfg. Co., Providence, R. I., which gives the machine all the advantages of power plunge-cutting with no change in its regular capacities or operating convenience. The arrangement furnishes 172 plunge-cut feeds or picks per minute, with the amount of feed adjustable by quarter-thousandths, from 0.00025 to 0.0045 per pick. As with the regular cross-feed, the stopping point can be set by increments of 0.0001 inch.

A separately controlled 1/20-H.P. geared-head motor at the front of the machine drives continuously a variable-radius crank mechanism which is mounted below a similar unit that is regularly a part of the machine. The arrangement includes a vertical link which transmits motion to the cross-feed pawl from either of the two crank mechanisms. Selection of feed for traversing or straight-in feed grinding is made simply by connecting the link to the proper crank mechanism through a machine screw and hardened bushing that fits either of two holes in the link. The amount of feed per pick of the pawl is selected simultaneously

by means of a pointer and a scale on the rotating member before the screw is tightened. The arrangement is simple, compact, and effectively guarded for safety. 80

Baldor Ball-Bearing Grinders

The Baldor Electric Co., 4357 Duncan Ave., St. Louis, Mo., has developed a new ball-bearing grinder, shown in Fig. 1, which has a 1/2-H.P., 3400 R.P.M. motor and is equipped with 7- by 1-inch Aloxite wheels.

The particular feature of this new grinder, known as No. 724, is the provision of shatter-proof glass eye-shields which accommodate a tubular light that illuminates both sides and the front of the wheel. With this lighting arrangement, there are no annoying shadows. Other features include spark breakers; a water pot attached to the grinder; and a tool-rest which is adjustable to and from the wheel, up and down, and can be tilted for angle grinding.

The No. 60 grinder, shown in Fig. 2, is now equipped with a capacitor type ball-bearing motor designed to eliminate danger of burning out, even though it is repeatedly subjected to overloads. 81

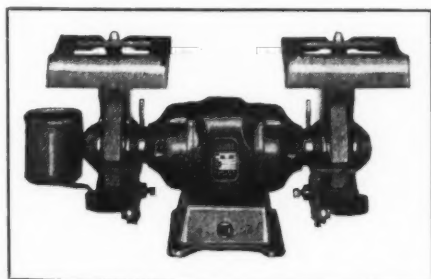


Fig. 1. Baldor No. 724 Grinder with Shatter-proof Glass Eye-shields

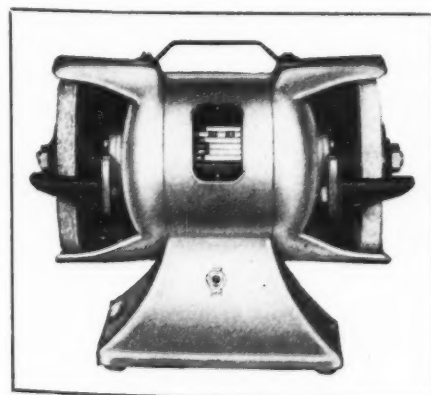
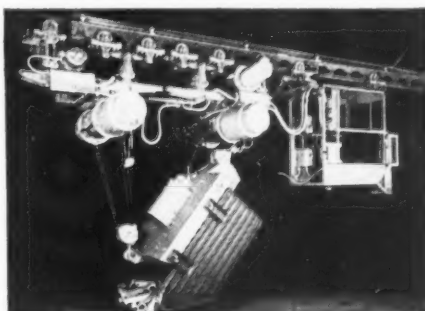


Fig. 2. Baldor No. 60 Grinder with Motor Designed to Handle Overloads

Tilting Box Grab and Tramrail Carrier

The Cleveland Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, has developed a new tilting box grab and tramrail carrier that picks boxes up, sets them down, or empties them by tilting, all operations being controlled from the cab.

The equipment consists of a cab-operated Cleveland tramrail motor-driven carrier with two independent hoisting units and motorized grab. The hoisting units make it possible to raise or lower boxes, as desired, and empty them as fast or as slowly as required. At distances of 30 or 40 feet below the carrier, boxes can



Tramrail Carrier with Cab Control for Handling Loads up to 3 Tons

be picked up or spotted in place easily and quickly by the cab operator. No floor men are required. The suspension brackets make it possible to interlock the boxes, thus facilitating stacking in even tiers.

The unit shown in the illustration was designed for handling a load of 3 tons, although units of any size up to 5 tons capacity can be furnished. The carrier travels on arch beam rails at a speed of 300 feet per minute. Tote boxes, spool boxes, and other types of containers can be handled with this equipment. 82

Stow Angle-Head for Close-Corner Drilling

A close-corner angle-head for use in drilling and filing with flexible-shaft machines is being brought out by the Stow Mfg. Co., Inc., 15 Shear St., Binghamton, N. Y. The compact dimensions of the unit make it usable in confined quarters. The over-all dimension from the drill socket to the top of the case is only 2 1/8 inches. The distance from the spindle center to the outside of the case is 9/16 inch.



Stow Angle Drilling Head for Flexible-shaft Machines

This unit has an aluminum housing containing two single-row ball bearings placed back to back on the vertical spindle, and a single-row ball bearing combined with a needle bearing on the horizontal spindle. High thrust capacity is obtained with this bearing arrangement.

The chuck which screws on the vertical spindle of the angle-head accommodates drills, rotary files, etc., with shanks up to 1/4 inch in diameter. For the closest work, short drills with 3/16-inch shanks can be inserted directly in the spindle and held in place by a set-screw. 83

Ideal Electric Etcher

Complete enclosure of all working parts is an outstanding feature of the No. 13 portable universal electric etcher just brought out by the Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill. The etcher tool and cords, switch, and indicator lamp are all enclosed. Small objects are etched while resting on the work-plate which makes up part of the case, while a ground clamp is furnished for use in performing etching operations on larger objects.

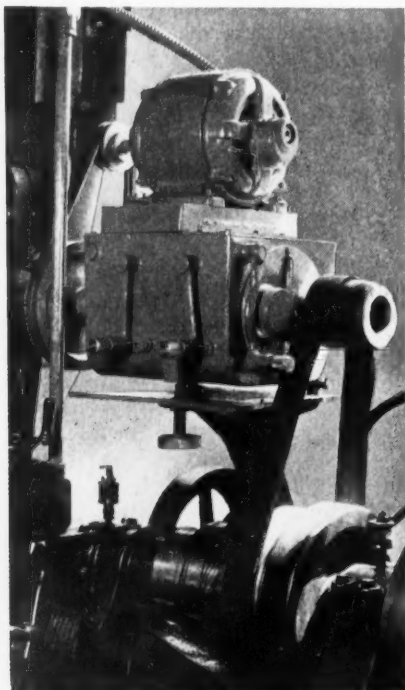
The current required for etching heats ranges from 120 to 700 watts. A red indicator lamp burns brightly as the hotter heats are turned on. This etcher is adapted for permanently marking tools, dies, bearings, saws, drills, products in process of manufacture, and finished parts. It

is as easy to write with this etcher as with a pencil, yet the marking is clearly and permanently burned into the metal. The standard unit is made to operate on 110-volt, 60-cycle alternating current, but the etcher can be built for operation on other voltages and frequencies. The dimensions are 7 1/4 by 5 1/8 by 8 1/2 inches, and the weight of the complete etcher is 16 pounds. 84

Heimroth Four-Speed Gear Drive

A new four-speed gear unit for converting belt-driven machine tools to motor-driven types has been placed on the market by the Heimroth Electric & Mfg. Co., Terre Haute, Ind. With this new unit, speed changing is accomplished by simply shifting a lever. The drive can be used on all machines originally equipped with cone drives, such as lathes, drill presses, shapers, milling machines, gear shapers, grinders, etc. Celeron silent gears are used in this unit.

The four-speed gear unit has a multiple-disk master clutch for disengaging the driving unit from the gear-shaft, so that speed changing from low to higher speeds can be accomplished without stopping the motor. This unit is built in four sizes ranging from 1 to 10 H.P., suitable for application to lathes from 9 to 36 inches. 85

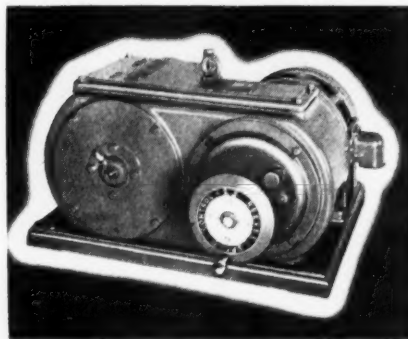


Gear Unit for Converting Machines from Belt to Motor Drive

Reeves "Speedial" Handwheel

The Reeves Pulley Co., Columbus, Ind., has developed an improved type of handwheel speed indicator for use with the Reeves variable-speed transmission, "Vari-Speed" motor pulley, and "Motodrive." This equipment, known as the "Speedial," accurately indicates speed settings of the different units. For each full turn of the shifting screw, the "Speedial," with pointer attached, registers one point or degree on the circular scale shown in the illustration.

The "Speedial" can be obtained at extra cost, if desired, in place of the standard speed control handwheel and indicator on the various Reeves drives. It is available for use both on new units and on units already in service. Gear ratios of 20 to 1,



Reeves "Motodrive" Equipped with "Speedial"

30 to 1, and 60 to 1 are available. The dial is calibrated in accordance with these ratios in from 0 to 20, 0 to 30, and 0 to 60 turns of the shifting screw. 86

Westinghouse "Flex-Arc" Welder

An all-purpose portable arc welder designed for general-utility service and production welding has just been placed on the market by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Regular models operate on either 220 or 440 volts, and are completely self-contained. From 20 to 250 amperes of welding current is available in twenty-seven current steps, with increments properly proportioned for welding with electrodes of a wide range of types and diameters. The current can be easily adjusted by simply inserting bayonet plugs in the proper receptacles. The current values are clearly indicated by large numerals.

A built-in "De-Ion" breaker in-



"Flex-Arc" Welder Built by the Westinghouse Electric & Mfg. Co.

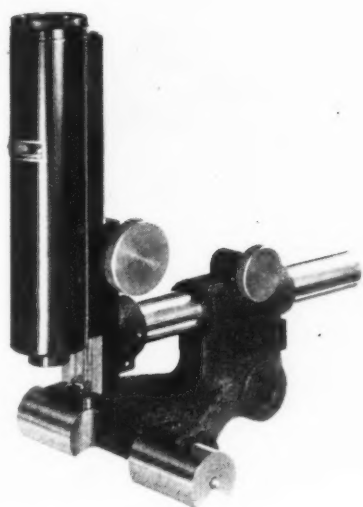
sures protection against long sustained overloads, such as might occur by accidentally leaving the machine short-circuited. This feature permits the operator to disconnect the machine from the line without going back to a service or feeder switch. Open circuit or striking voltage is exceptionally low, being about 80 volts at 20 amperes and ranging down to 50 volts at the highest current rating.

The welder is completely self-contained, being enclosed in a rugged steel case mounted on three wheels. All accessories, including welding helmet and electrode-holder, are furnished with the welder. 87

Optical Thread Tool Gage

Rapid, yet highly accurate, set-up of single-point threading tools is made possible by a new optical instrument brought out by the Gaertner Scientific Corporation, 1201 Wrightwood Ave., Chicago, Ill., which serves also for checking tool and thread angles. It consists of a specially mounted microscope with a large eye-piece field of 7/8 inch in which appear the characteristic angles of American National Standard, Whitworth, and metric threads. The microscope is mounted on a keyed cross-rod which slides for adjustment in a hole perpendicular to a mandrel in the base.

For setting up the threading tool perpendicular to the axis of the lathe centers, the female centers of the instrument mandrel are placed between the lathe centers and the cross-rod is adjusted until the point of the threading tool is in the field of the microscope. The threading tool is then adjusted in the toolpost until its out-

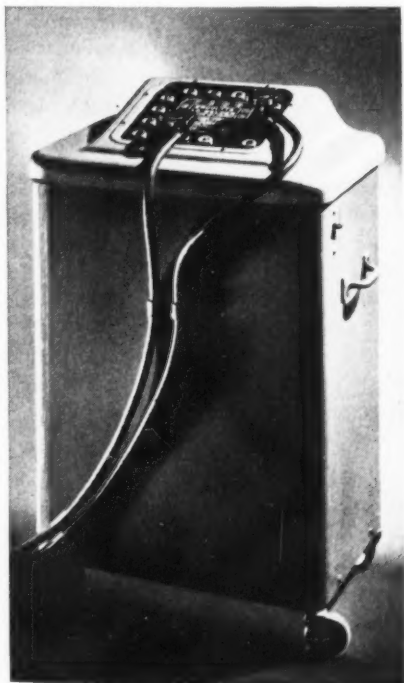


Caertner Optical Gage for Setting Threading Tool

line coincides with the corresponding angle in the microscope. This instrument is suitable for checking thread angles on work from 3/8 inch to 6 1/2 inches in diameter. 88

Ergolyte Arc Welders

The continuous alternating-current arc welders made by the Ergolyte Mfg. Co., 3644 Lawrence St., Philadelphia, Pa., have all controls and sockets located in full view on a sloped panel. This arrangement facilitates selecting the required



Arc Welder with Panel Control, Made by Ergolyte Mfg. Co.

heats and making adjustments. Heats can be selected in gradual steps over a wide range, and can be correctly proportioned to correspond to the commercial gages of metal handled. These welders have double-spun glass insulation. The current required at no load never exceeds 50 watts. Two models, No. 160 with a current range of 15 to 160 amperes, and No. 250 with a current range of 15 to 250 amperes, are available. 89

"Knu-Kam-Klamp"

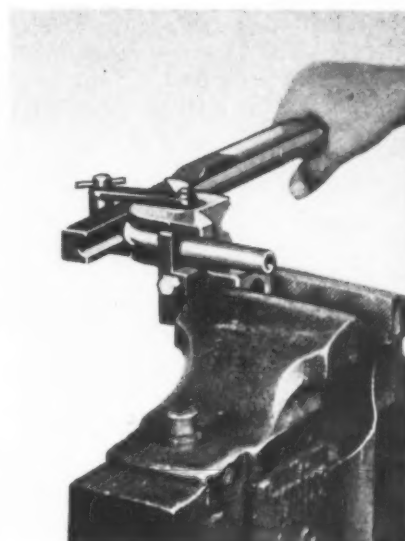
A toggle type clamp termed the "Knu-Kam-Klamp" has just been added to the line of work-holding devices made by Knu-Vise, Inc., 16841 Hamilton Ave., Detroit, Mich. This clamp is made in two sizes, both of which are interchangeable with the



"Knu-Kam-Klamp" Toggle Type Work-holding Clamp

regular type toggle clamps, Nos. 110 and 250, made by this concern. The new clamping device is similar to a toggle clamp in that it has a clamping bar hinged at one end, an operating handle, and a base member by which it is attached to the fixture. The link connecting the handle to the toggle bar is slotted, as shown in the illustration, to permit the bar to be withdrawn rapidly from the work. This link, however, plays no actual part in the clamping operation.

The upper portion of the toggle or clamping bar has a machined cam surface which is in contact with two rollers. When the handle is in the vertical position, these rollers are in contact with the low part of the cam surface and the toggle bar is in the maximum position for taking the thickest piece that can be held by the fixture. A continuous swinging movement of the handle forces the cam rollers against the rise of the cam, so that the toggle bar eventually reaches the minimum clamping position. These clamps have an adjustment range of between 7/8 and 1 inch. 90



Greenlee Hand Bender Made in Six Sizes

Hand Benders for Tubing

The Greenlee Tool Co. Division of Greenlee Bros. & Co., Rockford, Ill., has just added a hand-operated steel tube bender to its line of hydraulic benders for conduit and similar pipe. The new benders were developed to meet the requirements of speed and accuracy in bending steel, copper, brass, and other tubing in the machine tool, aviation, air-conditioning, refrigeration, and plumbing fields.

It is claimed that the new benders permit steel and other tubing to be bent without kinking or flattening. The bending is accomplished by a rolling action, which eliminates friction and leaves the finish of the tube unmarred.

Six sizes are available for bending tubing with outside diameters of 1/4, 5/16, 3/8, 1/2, 5/8, and 3/4 inch. All sizes are designed to make bends to a center line radius of two and one-half times the outside diameter of the tubing. The benders are ordinarily held in a vise, as shown in the illustration, but a tapped hole in the head permits using an auxiliary handle for bending small sizes or soft tubing without a vise. 91

Black & Decker Tapper

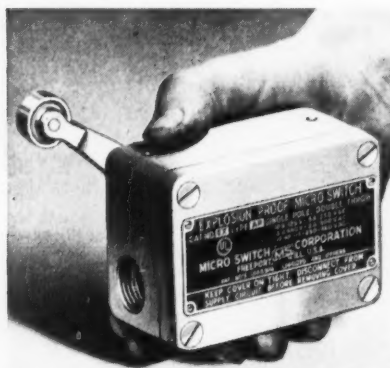
With the addition of the "Tapgun" to its line, the Black & Decker Mfg. Co., Towson, Md., now has three powerful, one-handed, high-speed production tools with identical grips and balance — namely, the "Holgun," "Tapgun," and "Scrugun."

The new "Tapgun" weighs only 3 3/4 pounds, is 9 1/4 inches long, and will tap 5/16-inch holes in cast

iron, 3/16-inch holes in steel, and 3/8-inch holes in brass or aluminum. The tapping and backing-out speeds are 400 R.P.M. and 525 R.P.M., respectively. 92

Small Explosion-Proof "Micro Switch"

An explosion-proof housing of unusually compact dimensions, 3 5/8 by 2 1/2 by 2 inches, designed to make use of the "Micro Switch" as the switching element, is offered to the trade by the Micro Switch Corporation, Freeport, Ill. This new switch is listed by the Underwriters for hazardous locations, Class 1, Groups C and D, and Class 2, Group G. These listings are for atmospheres containing vapors of ethyl



Explosion-proof Switch Made by Micro Switch Corporation

ether, gasoline, alcohol, acetone, lacquer solvents, etc., and for grain dusts.

The types of actuating members now available are the roller arm with the axis of the roller either parallel to or at right angles to the arm, and a bullet-nose push-rod. All types have precision characteristics, with a maximum movement differential of 0.001 inch. 93

Rotor Die-Grinders

The Rotor Tool Co., 17325 Euclid Ave., Cleveland, Ohio, has brought out two new air-operated die-grinders of the production type, known as the M-825 and the M-826, which will take wheels from 1/2 inch to 2 1/2 inches in diameter. The M-826 grinder is designed for use in inaccessible places, the side-to-center distance being only 19/32 inch. The spindle speed of this grinder is 17,000 or 21,000 R.P.M. This tool weighs 2 3/4 pounds.



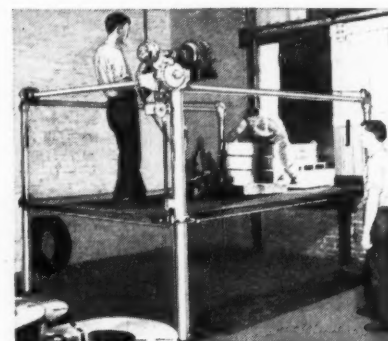
Die-grinder Made by the Rotor Tool Co., which can be Equipped with Either 13- or 26-inch Spindle Extension

The M-825 grinder has a spindle extension of either 13 or 26 inches, as shown in the accompanying illustration. This extension is adapted for use in cleaning up the inside of shells. The side-to-center clearance on this grinder is reduced to 1/2 inch. The weight is 7 pounds. Various types of handles, such as sleeve, twist, spade, button-safety, or right-angle throttle, are used interchangeably on both grinders. 94

do not damage the bolt thread nor mar the work surface, and the same nut can be used many times. 95

Walker Electric Lift for Industrial Plants

A simplified industrial electric lift that can be installed in a few hours on any floor of a building has just



Motor-driven Lift Built by the Walker Mfg. Co.

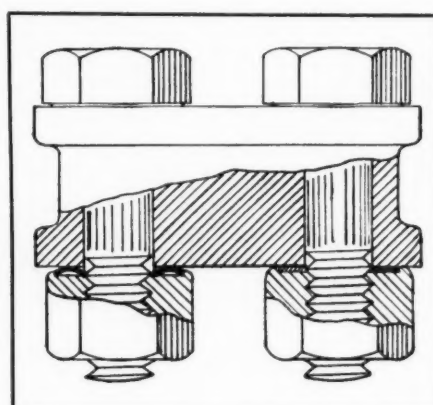
Self-Contained Lock-Nut

A self-contained, all-metal lock-nut has just been brought out by the An-cor-lox Division, Laminated Shim Co., Inc., 64 Union St., Glenbrook, Conn. This device, known as the "An-cor-lox" lock-nut, utilizes a new locking principle that enables the nut to be effectively and positively locked to the bolt instead of to the work.

The An-cor-lox nut is applied by simply spinning it on the bolt and drawing it to the desired degree of tightness. The metal locking ring contained in the bottom of the nut, as shown in the view to the left in the illustration, is expanded by the locking pressure into the "lock joint" as shown in the view to the right, so that it holds securely under all conditions of heat and vibration. These lock-nuts are available in all standard sizes and in all metals. They

been placed on the market by the Walker Mfg. Co., Racine, Wis. This lift will raise a load of 7500 pounds to any predetermined height up to 5 feet. It is adapted for raising and lowering loads between trucks and shipping-room floors and lifting parts to machine level, thus eliminating the necessity for ramps and skids.

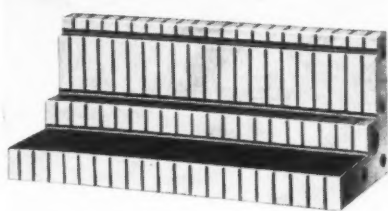
The lift consists of four tubular steel posts, a steel platform which is raised and lowered by steel cables, and a motor-driven drum. Two platform sizes are available—6 1/2 by 8 feet, and 6 1/2 by 16 feet. 96



"An-cor-lox" Lock-nut in Free and Locked Positions

Universal "Magne-Blox" Angle-Iron

The George Scherr Co., 128 Lafayette St., New York City, is placing on the market a universal "Magne-Blox" angle-iron designed for holding a wide variety of work on magnetic chucks. The new angle-iron has five steps, as shown in the illus-



"Magne-Blox" Angle-iron for
Magnetic Chucks

tration, which range from 3/16 inch to 1 5/8 inches in width. These steps will support pieces of various shapes for surface grinding without the use of complicated clamps and holding attachments. Over-all dimensions are 3 by 3 by 7 1/2 inches. 97

Small Steel-Treating and General-Utility Furnace

The National Safety Device Co., 836 W. Hubbard St., Chicago, Ill., has brought out a steel-treating and general-utility furnace of entirely new design, which is operated by the flame of a blow-torch. Any make or size or blow-torch can be used, the furnace being raised or lowered easily, so that the flame opening will be in line with the blow-torch burner, regardless of the height of the torch.

The top of the new furnace carries a pan of special heat-resisting iron which can be filled with sand and heated for drawing the temper of small tools. When the pan is removed, a top grating can be used to accommodate a lead or babbitt ladle. The door opens level with the bottom of the furnace, which enables the user to pull out the heated part on the open door for examination. The furnace is also useful for heating large soldering irons. It is lined with firebrick 3/4 inch thick. 98

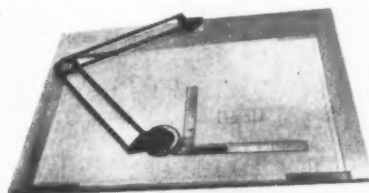


Steel-treating Furnace Operated
by Blow-torch

"Wrigraph Industro Drafter"

A new completely adjustable, ball-bearing drafting machine for drawings up to 24 by 36 inches has recently been placed on the market by L. G. Wright, Inc., 5209-41 Euclid Ave., Cleveland, Ohio, under the trade name "Wrigraph Industro Drafter." This precision instrument can be clamped to any drawing-board up to 2 inches thick by 36 inches wide. A variety of extension clamps are available for mounting the machine on wider drawing-boards.

A hinged mounting permits raising the machine clear of the board, and a leveling screw is provided for adjusting the machine to the plane of the drawing-board. The protractor head is controlled by the left hand. A 1/2-degree vernier equipped with a magnifier provides for quick, accurate setting to any angle. 99



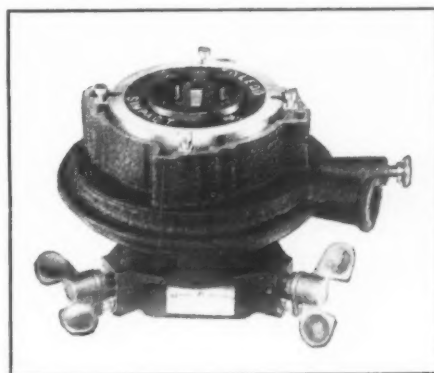
"Wrigraph" Adjustable Ball-bearing
Drafting Machine

able for toolmakers' and diemakers' use, which is known as Tamms "Blue Lay-Out Dope." It comes in liquid form, ready for immediate use, is blue in color, quick-drying, and will not rub off. A scribe or lay-out tool shows a clear, distinct line without chipping or scraping. 101

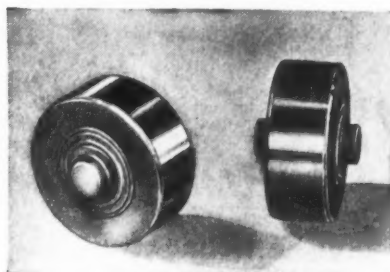
Toledo Self-Contained Ratchet Pipe-Threader

The Toledo Pipe Threading Machine Co., 1425-1445 Summit St., Toledo, Ohio, has brought out a new "Simpact" self-contained ratchet pipe-threader with a capacity range of 1 to 2 inches. This tool is designed to cut accurate tapered threads with a minimum of effort. It uses high-speed steel dies which can be quickly changed from one size to another simply by pushing the size-selecting buttons and sliding the dies into the proper steps. This arrangement saves about one-half the time usually required for changing from one size to another.

A rear gripping device is employed which is equipped with three broad-faced chuck jaws. Graduated guide posts and large wing-head thumb-screws assure easy and accurate centering of the tool on the pipe. A 24-inch, strong, tubular steel handle is provided. The deep-throated dies can be resharpened many times. 102



"Simpact" Pipe-threader with Capacity
Range of 1 to 2 Inches



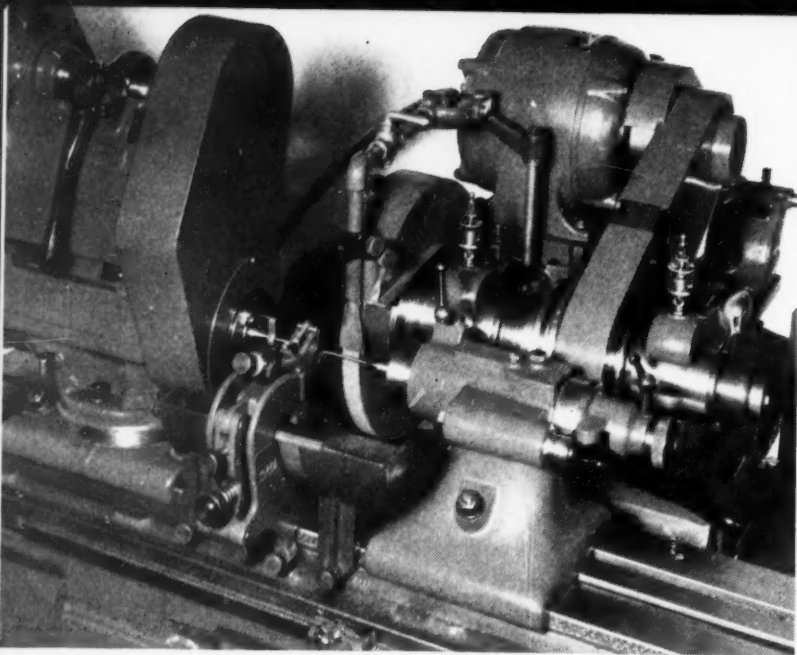
New Departure Ball-bearing
Treadle Rolls

New Departure Treadle Rolls

Because of the relatively short life obtained with plain types of treadle rolls in loom service, and their tendency to jam with lint and thus damage the cams, the New Departure Division General Motors Corporation, Bristol, Conn., has designed a special treadle-roll ball bearing to overcome these difficulties. The new treadle rolls are made of high-carbon chrome-alloy steel, extra heavily built to absorb shock, completely protected from dirt or lint, and lubricated for life. This ball bearing is easy rolling, cannot rub at the sides of the treadle arm, and its hard, smoothly finished surfaces do not become clogged with dirt. 100

Toolmakers' Lay-Out Dope

The Tamms Silica Co., 228 N. LaSalle St., Chicago, Ill., has recently developed a new lay-out dope suit-



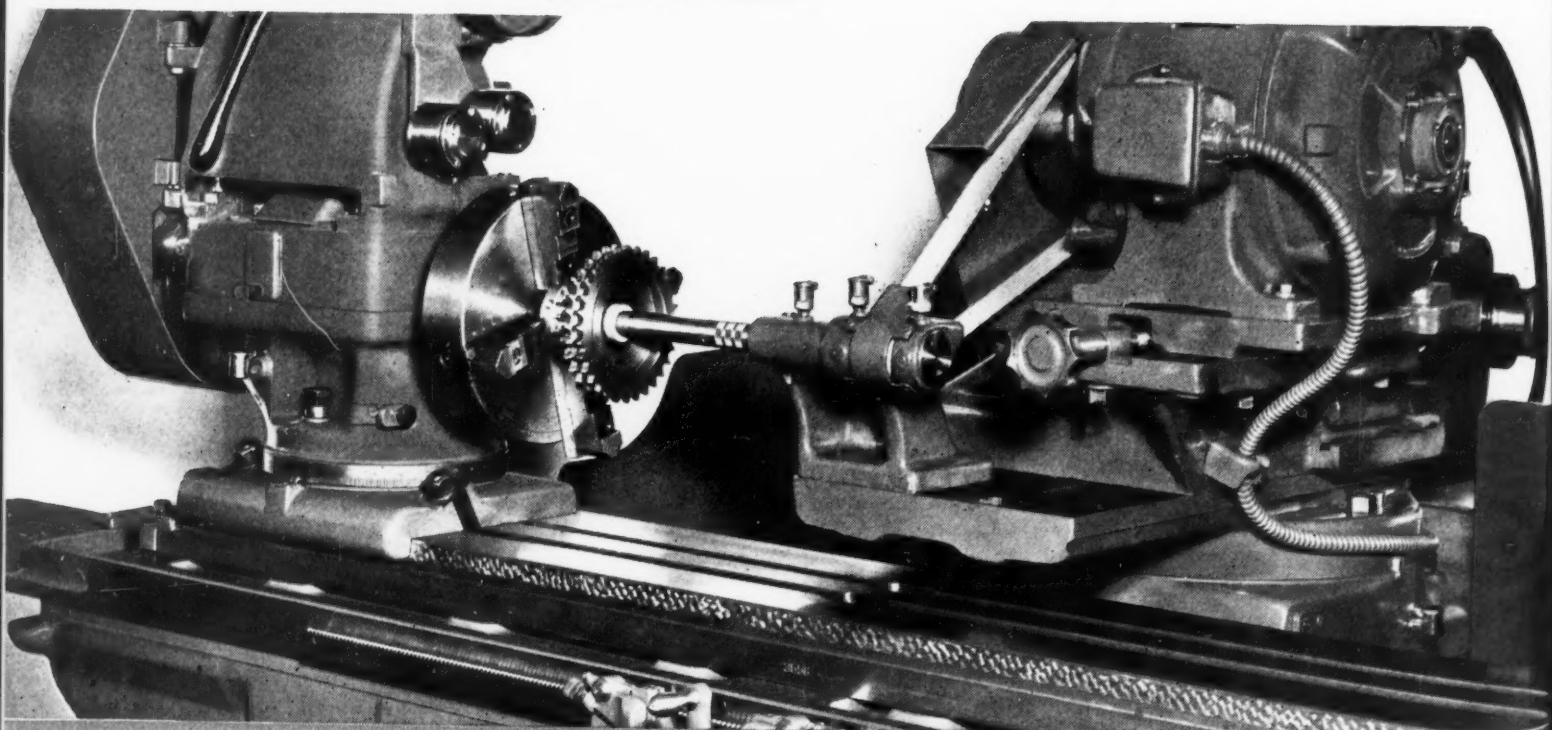
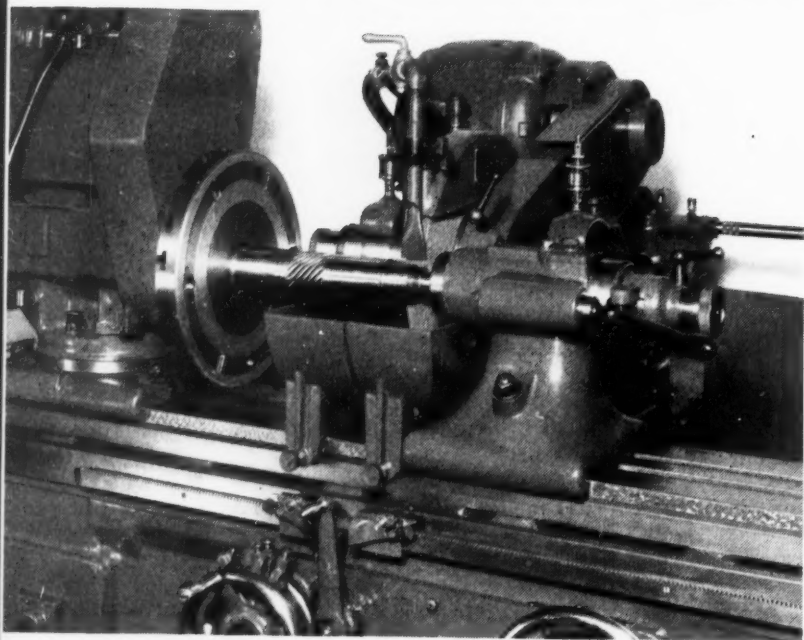
TRULY

... Investigate the

Flexibility of set-up

Ease of operation

Inexpensive to maintain



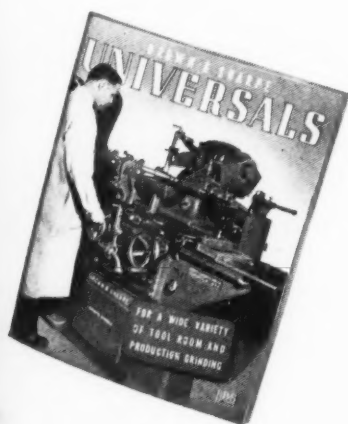
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UNIVERSAL

the *fast, modern* No. 2 Universal
for toolroom and production grinding

Light or heavy work, straight or taper,
external or internal . . . all are efficiently
ground on the really versatile No. 2 Uni-
versal Grinding Machine.

- ✓ Wide speed ranges to meet all conditions
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- ✓ Additional equipment available to extend the machines' range even further



All the above features, and many more, are fully described in the new booklet on Profitable Brown & Sharpe Universals. Write for **your** copy today. Nos. 3 and 4 Machines, to take longer work, are also included. Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

SHARPE

NEWS OF THE INDUSTRY

Indiana and Illinois

DEAN A. A. POTTER has been awarded the 1940 Lamme Medal by the Society for the Promotion of Engineering Education for his many achievements in the advancement of engineering education and its application to industry. The Lamme Medal was instituted in honor of the memory of Benjamin G. Lamme, a pioneer in engineering and electric power developments. At his death, in 1924, he was chief engineer of the Westinghouse Electric & Mfg. Co. Dean Potter, recipient of the medal, has been dean of the Schools of Engineering and director of the Engineering Experiment Station at Purdue University for the last twenty years. Born in Europe in 1882, Dean Potter came to the United States at the age of fifteen. He graduated from the Massachusetts Institute of Technology in 1903. After two years with the General Electric Co., he went to the Kansas State College as assistant professor of mechanical engineering, and from there went to Purdue. Dean Potter is a past-president of the American Society of Mechanical Engineers and of the Society for the Promotion of Engineering Education.

LOUIS ALLIS CO., Milwaukee, Wis., has opened an office at 8600 Pine Ave., Gary, Ind. DON L. ORTON, who has served industry in this area in a sales engineering capacity for many years, has been appointed factory representative in the Indiana district.

WILLIAM A. HANLEY, in charge of engineering, Eli Lilly & Co., Indianapolis, Ind., has been nominated for the office of president of the American Society of Mechanical Engineers for the year 1941.

H. D. HIATT, of the Allison Engineering Co., Indianapolis, Ind., has been elected chairman of the newly formed Indianapolis chapter of the American Society of Tool Engineers.

R. T. STEINDORF has been appointed district manager of the Chicago office of the Chain Belt Co., Milwaukee, Wis.

Maryland and New Jersey

W. LESLIE LAWRENCE has been elected secretary of the Alexander Milburn Co., Baltimore, Md. Mr. Lawrence has been connected with the company for many years in various capacities, and is a director. He succeeds Harvey H. Johnson, who recently passed away, after having been with the company for twenty-five years.

ALLEN W. MORTON, vice-president of Koppers Co. in charge of the American Hammered Piston Ring Division, Baltimore, Md., has been appointed full-time special assistant to EDWARD R. STETTINIUS, JR., chairman of the Advisory Commission to the Council of National Defense.

DRIVER-HARRIS CO., Harrison, N. J., announces that, at a recent meeting of the board of directors, FRANK L. DRIVER was elected president, and STANLEY M. TRACY executive vice-president and treasurer. JOHN DRENNAN, F. V. LINDSEY, and H. D. MCKINNEY were elected vice-presidents, and ERNEST A. HARLEMAN secretary and assistant treasurer.

Michigan

PROGRESSIVE WELDER CO., Detroit, Mich., has doubled its production capacity as the result of its transfer to the new plant recently completed at East Outer Drive. The floor space, however, is only 10 per cent greater than in the company's old mill type plant. Three months of operation in the new plant, which was designed and built by the Austin Co., has proved the advantages gained by operating in an up-to-date plant with plenty of daylight and modern handling equipment.

MICROMATIC HONE CORPORATION, manufacturer of honing machine tools, has moved to larger quarters at 1345 E. Milwaukee Ave., Detroit, Mich. The new quarters offer an increase in space of over 100 per cent.

JOHN S. RONEY has been appointed exclusive factory representative in eastern Michigan, for the MCKENNA METALS Co., Latrobe, Pa., with headquarters at 14425 Mark Twain Ave., Detroit, Mich.

Missouri and Nebraska

MEDART CO., Potomac and DeKalb Sts., St. Louis, Mo., has purchased the entire wood pulley stock of the REEVES PULLEY Co., at Columbus, Ind., and at all branch warehouses, as well as the good will of the wood pulley business of the Reeves company.

CONSTRUCTION PRODUCTS Co., 13th and Grace Sts., Omaha, Neb., has been appointed distributor in the Nebraska territory for the Rawlplug Co., Inc., 98 Lafayette St., New York City, manufacturer of anchorage devices, drills, accessories, etc.




Harry K. Clark, Vice-president and General Manager of the Norton Co.

New England

HARRY K. CLARK was recently elected vice-president and general manager of the Norton Co., Worcester, Mass., and ANDREW B. HOLMSTROM, vice-president and works manager. These appointments were made to fill vacancies recently caused by two resignations. ALDUS C. HIGGINS, president, who also held the office of general manager, resigned the latter position, and GEORGE N. JEPFSON, treasurer and vice-president, who also held the position of works manager, resigned the latter position. Mr. Higgins will retain the office of president, and Mr. Jepfson will continue to fill the offices of treasurer and vice-president. Mr. Clark has been with the company twenty-five years, having served in various positions in the selling organization, as well as holding the offices of direc-



Andrew B. Holmstrom, New Vice-president and Works Manager of the Norton Co.



Increased usability due to advanced design is the reason companies, both large and small, are specifying "Cincinnati Power Rapid Traverse Shapers." Plain and Universal Table models in ten sizes from 16" to 36".

Write for Catalogue N-1

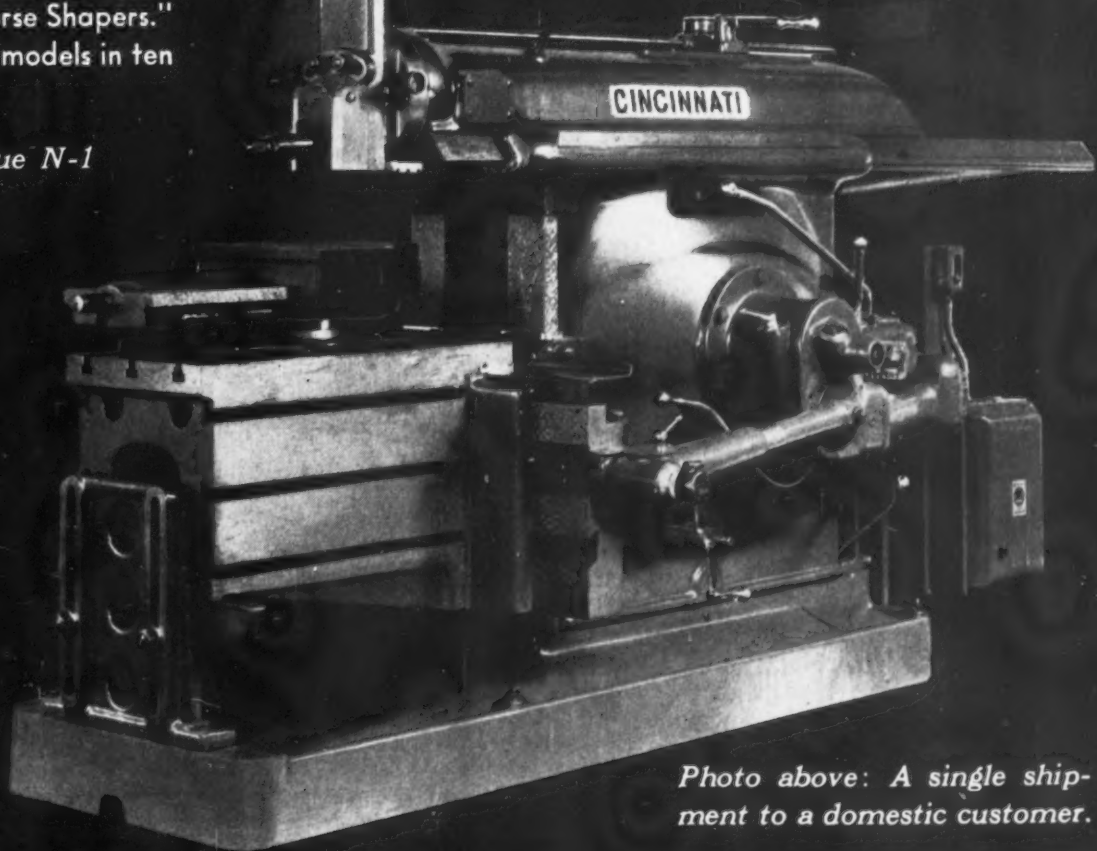


Photo above: A single shipment to a domestic customer.

THE CINCINNATI SHAPER COMPANY, CINCINNATI, OHIO

SHAPERS • SHEARS • BRAKES

tor and vice-president. He is also executive officer in charge of the Norton Co. of Canada, Ltd., a director of Behr-Manning Corporation, of Troy, N. Y., and a director of Australian Abrasives (Pty) Ltd., Sydney, Australia. Mr. Holmstrom has been connected with the company for twenty years, during which time he has had considerable experience as an engineer and in plant management. For five years he held the position of general manager of the Norton British plant, and previous to his present appointment served as works manager of the Abrasive Division.

UNITED AIRCRAFT CORPORATION, East Hartford, Conn., announces the following appointments: CHARLES H. CHATFIELD, executive assistant to the vice-president; FRANK W. CALDWELL, director of research; ERLE MARTIN, engineering manager of the Hamilton Standard Propellers Division; and JOSEPH M. BARR, factory manager of the Vought-Sikorsky Aircraft Division. All these men have been identified with the United Aircraft Corporation for several years.

HOLO-KROME SCREW CORPORATION, Hartford, Conn., announces that its increasing business has required the erection of an addition approximately 100 by 200 feet, in spite of the fact that a large addition to the plant was built seven months ago.

New York

ARTHUR VAN DELFT has joined the sales staff of William O'Neil, industrial designer, as sales manager for the New England territory. Mr. Van Delft's past experience has given him a familiarity with the point of view both of the designer and the manufacturer. He is himself a designer, and has also spent several years with the sales staffs of prominent organizations, promoting both consumer and commercial products. He will make his headquarters at 50 Rockefeller Plaza, New York City.

GEORGE CAMPBELL has been appointed manager of the Buffalo office of the General Electric Co., Schenectady, N. Y., succeeding GEORGE H. CALKINS, who retired after more than forty-one years of service with the company. RALPH M. DARRIN has been appointed manager of the Syracuse office, E. H. AUSSICKER manager of the Schenectady local office, and E. B. CURRIE manager of the Binghamton office.

JAMES H. CRITCHETT, vice-president of the Electro Metallurgical Co., vice-president of the Union Carbide and Carbon Research Laboratories, Inc., 30 E. 42nd St., New York City, and former president of the American Electro Chemical Society, has been appointed a member of the National Research Council. Mr. Critchett will serve on the Division of Chemistry and Chemical Technology.

WALTER JOSEPHSON, JR., formerly chief engineer and works manager of International Carbo-Ice, Ltd., and subsidiaries, in Toronto, Canada, and London, England, has become associated in the capacity of sales engineer with Greene, Tweed & Co., 101 Park Ave., New York City, manufacturer of hammers, mallets, and reversible ratchet wrenches.

GEORGE SCHIERR CO., INC., 128 Lafayette St., New York City, has been appointed national distributor for the line of micrometers manufactured by the Reed Small Tool Works, of Worcester, Mass. Complete stocks of Reed micrometers will be carried at the New York address of the company.

G. B. FLANIGAN has been appointed New York district manager of the Chain Belt Co., Milwaukee, Wis., to succeed W. H. QUINN, who died recently after seventeen years' association with the company. Mr. Flanigan was previously Chicago district sales manager.

AIR REDUCTION SALES CO., 60 E. 42nd St., New York City, announces that it has just completed the construction of a new acetylene plant at West Berkeley, Calif., in order to extend its servicing facilities to customers in San Francisco and vicinity.

DR. LINCOLN T. WORK, associate professor of chemical engineering at Columbia University, has been appointed director of research of the Metal & Thermit Corporation, 120 Broadway, New York City.

COSA OVERSEA TRADING CORPORATION has been organized at 5000-4 Chrysler Building, New York City, and will take over all business formerly transacted by E. T. LAUBSCHER, agent.

Ohio

J. RUSSELL PENMAN has been made production manager of the Copperweld Steel Co.'s new alloy steel plant at Warren, Ohio. Mr. Penman was previously connected with the Steel and Tube Division of the Timken Roller Bearing Co. and the United States Steel Corporation. W. C. MORGENSTERN is assistant chief engineer at the same plant. Mr. Morgenstern is a graduate of Cornell University, class of 1909, and has been connected with a number of well-known steel companies. W. J. BUECHLING is now chief metallurgist. He was previously connected with the Central Alloy Steel Corporation and the Republic Steel Corporation.

US ELECTRIC WELDER CORPORATION, 1224 W. Bancroft St., Toledo, Ohio, has been incorporated by J. L. FOSNIGHT, president of the corporation, who has acquired control of the USL electric welder. The latter will now be sold under the trade name "US Welder."

Mr. Fosnight has been associated with the Electric Auto-Lite Co. for more than twenty-four years as sales manager of the USL Welder Division.

HILL ACME Co. is the name of a new corporation formed as a result of the purchase by the HILL CLUTCH MACHINE & FOUNDRY Co. of the ACME MACHINERY Co., both of Cleveland, Ohio. A. C. McDANIEL is president of the new company; KARL F. BRUCH, vice-president; L. L. HERCIK, vice-president and general manager; MILO G. FIRESTONE, treasurer; and JOHN R. SHORT, secretary.

WESTINGHOUSE ELECTRIC & MFG. Co. is constructing a warehouse at a cost of \$560,000 at its Mansfield, Ohio, plant. This brings the cost of the expansion program now under way at this plant to about \$1,500,000. The new warehouse will provide 126,000 square feet of space, and is one of the major features of the expansion program. A new metal-stamping building costing more than \$500,000 is also being erected.

W. J. FREDERICK, of the Frederick Steel Co., Cincinnati, Ohio, has been elected chairman for the coming year of the Cincinnati chapter of the American Society of Tool Engineers.

R. J. FRIETER, chief engineer of the Columbus Bolt Co., Columbus, Ohio, has been elected chairman of the newly formed Columbus chapter of the American Society of Tool Engineers.

CLEVELAND PUNCH & SHEAR WORKS Co., 3917 St. Clair Ave., Cleveland, Ohio, has recently started operations in the 34,000 square-foot addition to its plant, which has added 25 per cent to the floor space and increased the production capacity of the plant by 50 per cent. The new structure was designed and built by the Austin Co.

C. O. BARTLETT has been appointed district manager in the Detroit territory for the C. O. Bartlett & Snow Co., Cleveland, Ohio, manufacturer of materials-handling and conveying machinery. Mr. Bartlett, who is the son of the founder of the company, is a graduate of the Case School of Applied Science, class of 1916.

JOHN W. ALDEN has joined the Steel and Tube Division of the Timken Roller Bearing Co., Canton, Ohio, as mill metallurgist. Mr. Alden is a graduate of Oberlin Academy and Columbia University, and was previously connected with the United Steel Co., Central Alloy Steel Corporation, and Republic Steel Corporation.

J. L. MORRISSEY, formerly connected with the National Acme Co., Cleveland, Ohio, in the capacity of sales manager of the Screw Products Division, has joined the Ferry Cap & Set Screw Co., Cleveland, Ohio, as vice-president in charge of industrial sales.

Throughout Industry...



THIS TRADEMARK

MEANS "MORE HOLES PER DOLLAR"!

**"HANDLES
WITH MINIMUM EFFORT"**

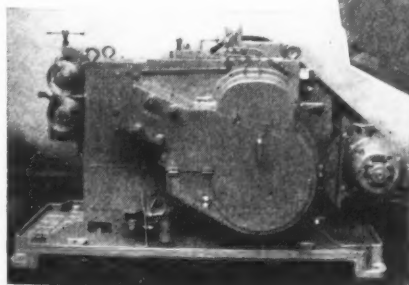
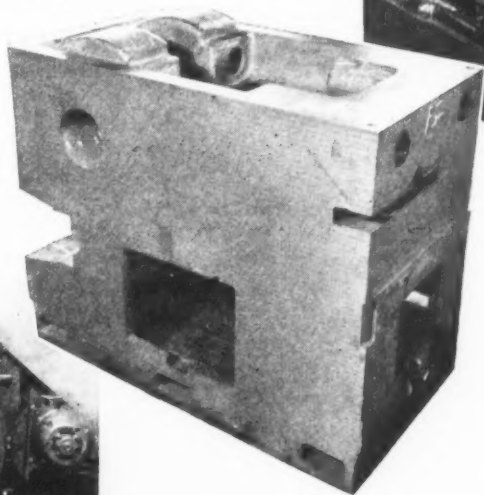
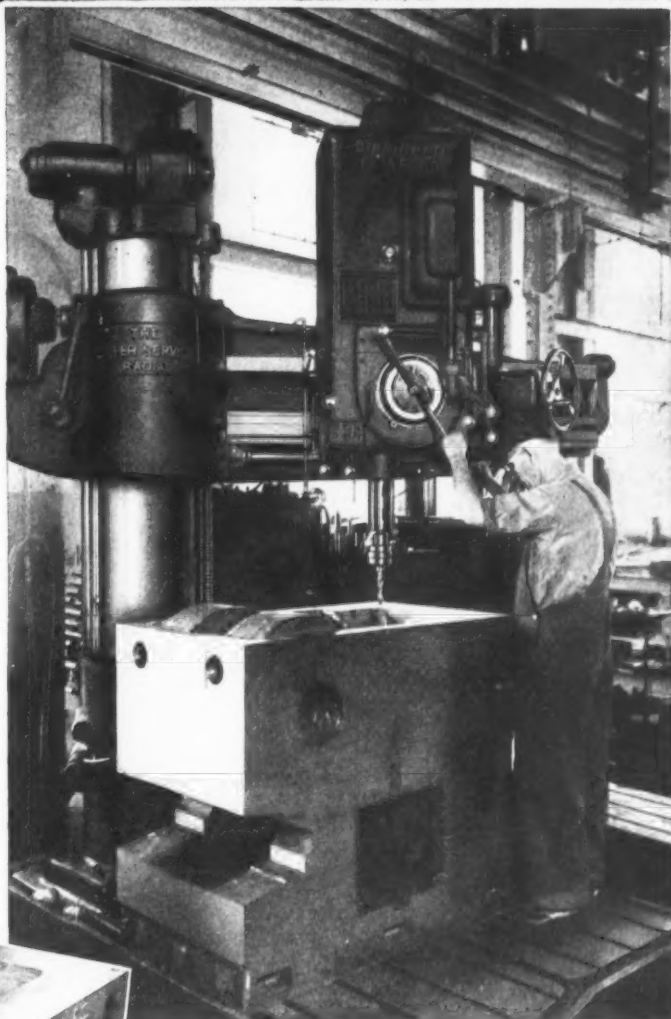
says Waterbury Farrel Foundry & Machine Co.

Operating convenience is an especially important feature in Radial Drill operation when the work is as large as the part illustrated.

Speed and feed, column and arm clamping, hand and power traverse, and elevation are all controlled at the head within easy reach of the operator of this Cincinnati Bickford Super Service Radial Drill.

The wide choice of feeds and speeds, positive safety measures for tools, machine and operator, are some of the reasons why this drill is well suited to the work of Waterbury Farrel and they say, "Performance entirely satisfactory."

*For complete details,
sizes and specifications write for Bulletin R-24.*



OPERATION DATA

Part: Cast iron frame for Solid Die Double Stroke "Hi-Pro" Header, 46"x25"x38".

Operations: Drill and tap 4 corner holes $\frac{7}{8}$ " diam., $2\frac{3}{4}$ " deep and 4 crankshaft bearing holes $\frac{7}{8}$ " diam., $1\frac{1}{2}$ " deep.

Total time—floor to floor: $1\frac{1}{2}$ hours.

THE CINCINNATI BICKFORD TOOL CO.

OAKLEY • CINCINNATI • OHIO • U. S. A.

Pennsylvania

WILLIAM W. BARNES, Philadelphia manager of the Air Reduction Sales Co., 60 E. 42nd St., New York City, has retired after thirty years of service in the oxy-acetylene industry. Mr. Barnes first became associated with that industry in 1910, when he joined the Davis-Bournonville Co. as Philadelphia sales manager. He held that position until 1922, when the Davis-Bournonville Co. was merged with the Air Reduction Sales Co. Mr. Barnes then became manager of the latter company in Philadelphia.

T. E. COOK has been appointed sales representative in the Chicago district for the Jessop Steel Co., Washington, Pa., with headquarters at 1742 Carroll Ave., Chicago, Ill. J. W. STRANAHAN has been appointed sales representative in the Cleveland district, with headquarters at 1210 E. 55th St., Cleveland, Ohio. C. E. SPRAGG, formerly in the New York office, has been transferred to the Boston district office, with headquarters at 626 Capitol Ave., Hartford, Conn.

HOWARD R. SALISBURY has been appointed manager of the Philadelphia district of the Air Reduction Sales Co., New York City. Mr. Salisbury has been in the company's employ for fifteen years. H. B. SEYDEL, formerly assistant sales manager in the New York district, has been appointed assistant manager in the Philadelphia district.

GEORGE H. ALEXANDER MACHINERY LTD., of Birmingham, England, in conjunction with PHILIP M. McKENNA, of the McKenna Metals Co., Latrobe, Pa., have organized KENNAMETAL OF CANADA, LTD., for manufacturing Kennametal, the new steel cutting carbide, for Canada and the British Dominions. The main office and factory will be in Hamilton,



Philip M. McKenna, Founder and President of Kennametal of Canada, Ltd.



Arthur H. Alexander, General Manager of Kennametal of Canada, Ltd.

Ontario. Mr. McKenna is president of the firm, and ARTHUR H. ALEXANDER of Victoria, British Columbia, has been named general manager. Mr. Alexander is a member of the firm of George H. Alexander Machinery Ltd.

ALLEGHENY LUDLUM STEEL CORPORATION, Pittsburgh, Pa., has appointed the following agents for Allegheny Ludlum tool and high-speed steels: PEDEN IRON & STEEL CO., Houston, Tex.; MURRAY-BAKER-FREDERIC, INC., New Orleans, La.

SKF INDUSTRIES, INC., Philadelphia, Pa., has recently completed a new plant at Pennsylvania Railroad and Bridge St., which is the third SKF factory constructed in Philadelphia. The new building contains 226,000 square feet of floor space, and will be devoted exclusively to the manufacture of anti-friction bearings.

S. M. WASHBAUGH has been appointed sales representative for the National Screw & Mfg. Co., Cleveland, Ohio. Mr. Washbaugh's territory will be Pennsylvania and the northern part of Maryland, with headquarters in Williamsport, Pa., where he formerly was connected with Sweet's Steel Co.

Wisconsin

GEORGE GORTON MACHINE CO., Racine, Wis., manufacturer of milling, die and mold duplicating, and engraving machines, announces the completion of a 12,000 square-foot factory addition. The new structure houses the assembly and shipping departments, as well as the stock-room. Although the building was erected primarily to relieve congestion in the assembly department, it is expected to increase the machine output by about 25 per cent.

DAVIS & THOMPSON Co., Milwaukee, Wis., has changed ownership, but will continue to operate as formerly, manufacturing Davis "Roto-Matic" and other high-production machinery, as well as Davis tubular micrometers in crescent and bar types. WILLIAM H. WEIMER, vice-president and general manager, will be in charge of the plant.

CUTLER-HAMMER, INC., 324 N. 12th St., Milwaukee, Wis., manufacturer of electrical equipment, announces the removal of the Pittsburgh office to new and larger quarters in the Park Building at 355 Fifth Ave.

OBITUARY

Louis E. Murphy

Louis E. Murphy, formerly president and chairman of the board of E. F. Houghton & Co., Philadelphia, Pa., man-



Louis E. Murphy

ufacturers of oils, leathers, and metal-working products, died on June 26 at his summer home at Mantalocking, N. J., following a short illness culminated by double pneumonia. He had been connected with the Houghton organization for fifty-two years, having started as an errand boy in 1888. He was elected secretary of the company in 1910, vice-president in 1914, and president at the time of Charles E. Carpenter's death in 1929. He became chairman of the board in 1934, when A. E. Carpenter was made president. After his resignation in 1936, he continued as a director up to the time of his death. From 1931 until his retirement he was editor of "The Houghton Line."

Precision **HOLE LAPPING**
NOW ECONOMICAL... with

E

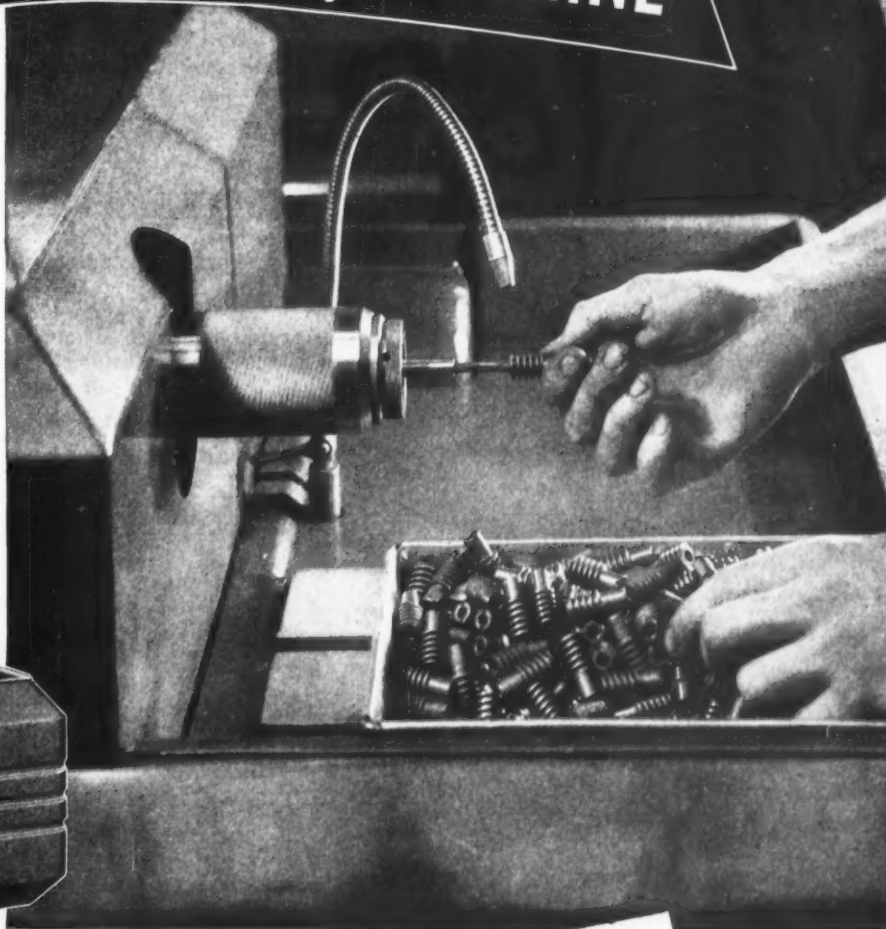
xclusive

advanced design of stones and mandrels, plus extreme ease of operation and control, makes it possible to finish holes to very close limits on the Ex-Cell-O Internal Lapping Machine at a new low cost... on a high production basis.

Due to far greater stone contact area, ordinarily difficult and expensive grinding and finishing operations, such as holes interrupted with keyways, slots, etc., are precision lapped on this Ex-Cell-O machine just as easily as plain holes... stone wear is greatly minimized... the necessity for frequent checking and resetting is reduced.

Send for complete information on this money-saving machine. Initial cost is surprisingly low.

EX-CELL-O *Internal Lapping* MACHINE



BETTER JOB... GREATER PRODUCTION
Worm shown lapped on Ex-Cell-O Internal Lapping Machine by Gear Specialties, Chicago. Former bellmouth conditions eliminated and production increased 50%.
PART—Worm blank • MATERIAL—4615 SAE steel, carburized and hardened • STOCK REMOVED—.0005" • SIZE OF HOLE—.21875" • TOLERANCE—.0003" • PRODUCTION—from 90 to 100 parts per hour.



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**MACHINES
AND TOOLS**

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COMING EVENTS

SEPTEMBER 3-6 — Fall meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Spokane, Wash. Further information may be obtained by addressing C. E. Davies, secretary, 29 W. 39th St., New York City.

SEPTEMBER 18-20 — Eighteenth annual conference of the NATIONAL INDUSTRIAL ADVERTISERS ASSOCIATION to be held at the Hotel Statler, Detroit, Mich. For further information, address National Industrial Advertisers Association, Inc., 100 E. Ohio St., Chicago, Ill.

SEPTEMBER 24-25 — NATIONAL TRACTOR MEETING OF THE SOCIETY OF AUTOMOTIVE ENGINEERS at Schroeder Hotel, Milwaukee, Wis. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

OCTOBER 7-11 — NATIONAL SAFETY CONGRESS AND EXPOSITION to be held at the Stevens Hotel, Chicago, Ill., under the auspices of the National Safety Council, 20 N. Wacker Drive, Chicago, Ill.

OCTOBER 8-12 — SOUTHERN POWER AND ENGINEERING SHOW in the Armory Auditorium, Charlotte, N. C. For further information, address Junius M. Smith, vice-president, Southern Power and Engineering Show, Inc., P. O. Box 1225, Charlotte, N. C.

OCTOBER 14-16 — Twenty-third semi-annual meeting of the AMERICAN GEAR MANUFACTURERS ASSOCIATION to be held at Skytop Lodge, Skytop, Pa. J. C. McQuiston, manager-secretary, 602 Shields Bldg., Wilkesburg, Pa.

OCTOBER 17-19 — Semi-annual convention of the AMERICAN SOCIETY OF TOOL ENGINEERS in Cincinnati, Ohio. Ford R. Lamb, executive secretary, 2567 W. Grand Blvd., Detroit, Mich.

OCTOBER 21-25 — NATIONAL METAL EXPOSITION, to be held at Cleveland, Ohio, under the auspices of the American Society for Metals. W. H. Eisenman, secretary, 7301 Euclid Ave., Cleveland, Ohio.

OCTOBER 31-NOVEMBER 2 — National Aircraft Production Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Hotel Biltmore, Los Angeles, Calif. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

DECEMBER 2-5 — Annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in New York City. Further information can be obtained from C. E. Davies, secretary, 29 W. 39th St., New York City.

DECEMBER 2-7 — Fourteenth NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING to be held at the Grand Central Palace, New York City. For further information, address International Exposition Co., Grand Central Palace, New York City.

JANUARY 6-10, 1941 — Annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at Book-Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

MARCH 24-29, 1941 — MACHINE AND TOOL PROGRESS EXHIBITION at Convention Hall, Detroit, Mich., under the auspices of the American Society of Tool Engineers, 2567 W. Grand Blvd., Detroit, Mich.

MAY 19-23, 1941 — WESTERN METAL CONGRESS AND EXPOSITION to be held in Los Angeles, Calif., under the auspices of the American Society for Metals. The Congress will have headquarters at the Biltmore Hotel, and the Exposition will be held in the Pan American Auditorium. W. H. Eisenman, secretary, 7301 Euclid Ave., Cleveland, Ohio.

* * *

Henry Disston & Sons Celebrate One-Hundredth Anniversary

Henry Disston & Sons, Inc., Philadelphia, Pa., pioneer saw manufacturers in the United States, celebrate this year the one-hundredth anniversary of the founding of the company. In honor of the event, on May 24—the date of the founding—S. Horace Disston, president of the firm, dedicated a memorial gate



at the Disston Athletic Field before an assemblage of more than 1000 employees and friends of the company.

It is of interest to note that the management of the business has remained in the hands of the same family for an entire century. The founder of the company, Henry Disston, was twenty-one years old when he started the business in the basement of his home in Philadelphia at a time when most saws were imported from England. Today, the company manufactures two thousand different products, spread over many fields. Besides the Philadelphia plant, the company has branch factories at Toronto, Canada; Sydney, Australia; and Seattle, Wash.

* * *

One-Hundredth Anniversary Celebrated by Worthington

In 1840, Henry R. Worthington invented the first direct-acting steam pump with a single-acting water cylinder. This pump revolutionized the practice of pumping of that day. It was upon this foundation that the Worthington business was founded. In 1845, Mr. Worthington formed a partnership with William H. Baker, the firm then being known as Worthington & Baker. Their first shop was a small wooden building, 30 by 60 feet, located opposite the old Navy Yard in Brooklyn, N. Y.

From that time on, the business has gradually grown until today the Worthington Pump & Machinery Corporation, with headquarters at Harrison, N. J., and factories in several industrial centers throughout the country, is well known as a manufacturer of equipment in many fields, including pumping, irrigation, steam power station equipment, Diesel and gas engine power equipment, petroleum industry equipment, compressors, etc. With offices and representatives all over the world, the company occupies a position of international importance.

* * *

Commercial Standard for Portable Electric Drills

The National Bureau of Standards, Washington, D. C., is submitting to industry for acceptance a recommended commercial standard for portable electric drills, exclusive of high-frequency drills. The new standard is known as TS-2902.

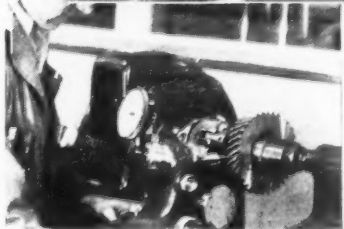
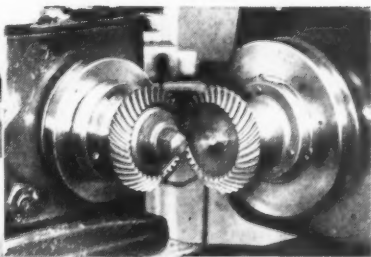
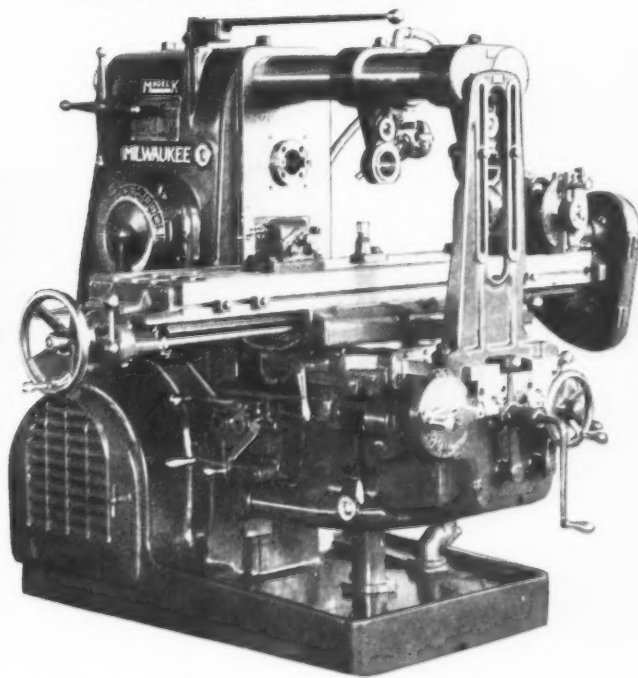
On the Occasion of the One-hundredth Anniversary of the Founding of Henry Disston & Sons, Inc., George Metzger, Eighty-three Years Old, Who has Worked for the Company for Seventy Years, was Presented with a Pin Set in Diamonds in Recognition of His Long Service. R. T. Nalle, Second Vice-president in Charge of Manufacturing, is Pinning the Award to Mr. Metzger's Lapel.

To Assure PRECISION GEARS...

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... TWO COMPLETELY EQUIPPED
GEAR LABORATORIES

PRECISION gears are vital to the sustained accuracy and performance of milling machines. Cut to exacting tolerances by the finest and most complete equipment obtainable, gears for Milwaukee Milling Machines must, in addition, pass precision tests for profile, lead, bearing, involute, runout, radial and silent operation. Two completely equipped gear testing laboratories are synchronized with production operations to guarantee the fullest measure of accuracy.

KEARNEY & TRECKER CORPORATION
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Gear laboratories and three of many precision tests in the production of gears for Milwaukee Milling Machines.



Milwaukee **MILLING
MACHINES**

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MACHINERY'S DATA SHEETS 401 and 402

PHYSICAL PROPERTIES AND APPLICATIONS OF FORGING METALS—1

S A E No.	Approximate Composition, Per Cent					Average Physical Properties*					
	Carbon	Nickel	Chromium	Molybdenum	Vanadium	Tensile Strength, Pounds per Sq. In.		Yield Point, Pounds per Sq. In.		Elongation in Two Inches, Per Cent	
						Heat- Treated	Annealed	Heat- Treated	Annealed	Heat- Treated	Annealed
Carbon Steels											
1020	0.20	....	....	....	....	75,000	60,000	45,000	35,000	25	36
1025	0.25	....	....	....	....	80,000	62,000	48,000	37,000	24	34
1030	0.30	....	....	....	....	90,000	65,000	62,000	40,000	23	33
1035	0.35	....	....	....	....	100,000	68,000	75,000	45,000	21	32
1040	0.40	....	....	....	....	116,000	72,000	82,000	48,000	17	28
1045	0.45	....	....	....	....	130,000	76,000	90,000	51,000	10	24
1050	0.50	....	....	....	....	145,000	81,000	94,000	54,000	8	22
Free-Cutting Steels											
1120	0.20	0.11 (Sulphur)	....	....	....	72,000	58,000	43,000	34,000	25	35
X1330	0.30	0.11 (Sulphur)	1.5 (Man- ganese)	....	....	140,000	90,000	110,000	62,000	16	28
X1340	0.40	0.11 (Sulphur)	1.5 (Man- ganese)	....	....	150,000	96,000	120,000	66,000	13	26
Carburizing Steels											
1015	0.15	....	....	....	....	72,000	54,000	42,000	32,000	25	36
X1315	0.15	....	....	0.11 (Sul- phur)	1.5 (Man- ganese)	90,000	67,000	67,000	44,000	25	38
2315	0.15	3.50	....	....	....	130,000	65,000	100,000	48,000	20	32
2515	0.15	5.00	....	....	....	140,000	75,000	110,000	51,000	20	37
3115	0.15	1.25	0.60	....	....	140,000	70,000	110,000	50,000	15	37
3312	0.10	3.50	1.50	....	....	180,000	90,000	140,000	65,000	15	25
4615	0.15	1.80	....	0.25	....	130,000	65,000	95,000	47,000	18	30
4815	0.15	3.50	....	0.25	....	140,000	75,000	110,000	50,000	18	32
6115	0.15	....	0.95	....	0.18	130,000	70,000	90,000	48,000	20	30
*The physical properties given in this table for heat-treated metals are obtained by tempering at 800 degrees F. after a suitable quench. Carbon steels are quenched in water, the other steels being quenched in oil.											

MACHINERY'S Data Sheet No. 401, September, 1939

Compiled by the Steel Improvement
and Forge Co., Cleveland, Ohio

PHYSICAL PROPERTIES AND APPLICATIONS OF FORGING METALS—2

S A E No.	Average Physical Properties*				Machin- ability Rating†	General Applications
	Reduction in Area, Per Cent		Brinell Hardness Number			
	Heat- Treated	Annealed	Heat- Treated	Annealed		
Carbon Steels						
1020	64	72	163	120	100	1020 For general forging purposes requiring an economical steel with fairly good properties and not requiring heat-treating or fine machine work.
1025	60	71	170	126	101	
1030	58	70	179	134	104	Economical steels with moderate physical properties for general-purpose requirements. Respond nicely to heat-treatments and machine well when properly annealed. Increasing carbon content imparts increasing strength with decreasing ductility.
1035	53	70	217	140	99	
1040	50	65	235	149	95	
1045	46	56	255	166	90	
1050	38	52	277	179	85	
Free-Cutting Steels						
1120	64	70	149	118	120	1120 Fairly good physical properties with better machining properties in many cases than S A E 1020.
X1330	40	60	285	170	105	
X1340	38	55	321	187	100	X1330 } Used for improved machinability, deeper hardening, and X1340 } better physical properties than S A E 1035 to 1045.
Carburizing Steels						
1015	64	72	137	107	90	1015 For moderate conditions and maximum economy. To obtain strictly uniform results, a guaranteed carburizing quality should be used. X1315 Provides better machining qualities and a stronger core than obtainable in S A E 1015.
X1315	60	70	179	134	116	
2315	63	76	262	137	100	2315 For greater core toughness than S A E 1015, with minimum distortion. Machines well and is suitable for single quench in many cases.
2515	65	72	285	156	80	2515 Greater core toughness than S A E 2315. For high-quality parts. Not so easily machined as S A E 2315, but annealing improves machinability. Offers minimum distortion. Desirable for single-quench operation.
3115	60	76	277	146	95	3115 An economical alloy steel for greater strength than plain carbon steel. Forges and machines easily, and hardens uniformly.
3312	56	74	341	207	70	3312 High strength and toughness for heavy pressure, impact, and wear. A sensitive steel that requires good equipment and care in forging and heat-treating operations.
4615	58	74	262	181	96	4615 Offers a deep hard case with good core properties and fine machinability.
4815	58	74	285	179	74	4815 For greater core strength than given by S A E 4615. Comparable with S A E 2315 for physical properties.
6115	62	72	262	143	90	6115 Offers high surface hardness with good core properties, resistance to shock, and retarded grain growth. Suitable for single-quench operation in many cases.
*The physical properties given in this table for heat-treated metals are obtained by tempering at 800 degrees F. after a suitable quench. Carbon steels are quenched in water, the other steels being quenched in oil.						
†Machinability is based on rating of 100 for S A E 1020 carbon steel.						

MACHINERY'S Data Sheet No. 402, September, 1939

Compiled by the Steel Improvement
and Forge Co., Cleveland, Ohio

MACHINERY, September, 1939—8-A

MACHINE'S DATA SHEET NO. 402

PHYSICAL DATA SHEET NO. 402

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MACHINERY'S DATA SHEETS 403 and 404

PHYSICAL PROPERTIES AND APPLICATIONS OF FORGING METALS—3

S A E No.	Approximate Composition, Per Cent					Average Physical Properties*					
	Carbon	Nickel	Chromium	Molybdenum	Vanadium	Tensile Strength, Pounds per Sq. In.		Yield Point, Pounds per Sq. In.		Elongation in Two Inches, Per Cent	
						Heat- Treated	Annealed	Heat- Treated	Annealed	Heat- Treated	Annealed
Medium-Carbon Alloy Steels											
T1330	0.30	....	....	1.7 (Man- ganese)	....	160,000	80,000	140,000	58,000	15	33
2330	0.30	3.50	....	....	....	160,000	80,000	140,000	58,000	15	26
2335	0.35	3.50	....	....	....	170,000	85,000	150,000	63,000	14	25
3130	0.30	1.25	0.60	....	....	160,000	80,000	140,000	58,000	15	26
3135	0.35	1.25	0.60	....	....	170,000	85,000	145,000	62,000	14	25
3230	0.30	1.75	1.10	....	....	180,000	90,000	152,000	66,000	14	25
3235	0.35	1.75	1.10	....	....	186,000	95,000	160,000	69,000	13	24
3335	0.35	3.50	1.50	....	....	190,000	100,000	168,000	75,000	12	22
3435	0.35	3.00	0.80	....	....	187,000	98,000	163,000	72,000	12	22
4130	0.30	....	0.65	0.20	....	160,000	80,000	140,000	58,000	16	28
4135	0.35	....	0.95	0.20	....	170,000	85,000	145,000	62,000	15	26
6130	0.30	....	0.95	....	0.18	170,000	80,000	145,000	59,000	13	23
6135	0.35	....	0.95	....	0.18	175,000	85,000	148,000	62,000	12	22
Corrosion-Resisting Steels (Stainless Type)											
410	0.10	....	13.00	....	....	190,000	70,000	160,000	40,000	16	35
416	0.10	....	13.00	0.30 (Sul- phur)	....	160,000	70,000	125,000	40,000	16	35
420	0.35	....	13.00	....	....	250,000	.....	220,000	.....	..	..
430	0.10	....	17.00	....	....	.....	80,000	.....	50,000	..	35
440	0.70	....	17.00	....	....	250,000	.....	235,000	.....	..	..
302	0.15	18.00	8.00	....	....	.....	85,000	.....	40,000	..	55
303	0.15	18.00	8.00	0.25 (Se- lenium)	....	.....	85,000	.....	40,000	..	55
304	0.07	18.00	8.00	....	....	.....	85,000	.....	40,000	..	55
502	0.08	....	5.00	0.50	....	.....	70,000	.....	35,000	..	35
*The physical properties given in this table for heat-treated metals are obtained by tempering at 800 degrees F. after a suit- able quench. Carbon steels are quenched in water, the other steels being quenched in oil.											

*The physical properties given in this table for heat-treated metals are obtained by tempering at 800 degrees F. after a suitable quench. Carbon steels are quenched in water, the other steels being quenched in oil.

MACHINERY'S Data Sheet No. 403, October, 1939

Compiled by the Steel Improvement and Forge Co., Cleveland, Ohio

PHYSICAL PROPERTIES AND APPLICATIONS OF FORGING METALS—4

S A E No.	Average Physical Properties*				Machin- ability Rating†	General Applications
	Reduction in Area, Per Cent		Brinell Hardness Number			
	Heat- Treated	An- nealed	Heat- Treated	An- nealed		
Medium-Carbon Alloy Steels						
T1330	45	65	321	149	90	T1330 Better physical properties and machining qualities than obtain- able in plain carbon steels.
2330	52	65	341	149	90	2330 } Natural strength, toughness, and resistance to shock or impact. 2335 } Improved by heat-treatment. Desirable for long parts requiring minimum distortion in heat-treatment.
2335	52	65	363	156	88	
3130	52	65	341	149	86	3130 } Greater strength and toughness, with deeper hardening prop- erties than plain carbon steels. Handle easily, machine well, and 3135 } have good properties in the heat-treated state.
3135	50	63	352	156	85	
3230	48	63	352	174	80	3230 } Greater strength and toughness than S A E 3130 and 3135. Harden 3235 } to greater depth, making them desirable for large sections.
3235	45	60	388	187	76	
3335	50	63	388	197	64	3335 } For heat-treated forged parts requiring exceptionally high phys- ical properties and resistance to severe dynamic stresses. Very 3435 } sensitive, requiring good equipment and care in forging and heat- treating operations.
3435	52	62	375	197	72	
4130	52	65	341	149	92	4130 } Used interchangeably with S A E 2330, 2335, 3130, and 3135. Have 4135 } better machining properties in heat-treated state than most sim- ilar-purpose alloy steels.
4135	50	62	352	156	90	
6130	48	60	341	156	80	6130 } Used interchangeably with similar-purpose alloy steels in same 6135 } carbon range. Desirable for parts subjected to impact.
6135	46	58	352	174	78	

*The physical properties given in this table for heat-treated metals are obtained by tempering at 800 degrees F. after a suitable quench. Carbon steels are quenched in water, the other steels being quenched in oil. †Machinability is based on rating of 100 for S A E 1020 carbon steel.

*The physical properties given in this table for heat-treated metals are obtained by tempering at 800 degrees F. after a suitable quench. Carbon steels are quenched in water, the other steels being quenched in oil. †Machinability is based on rating of 100 for S A E 1020 carbon steel.

MACHINERY'S Data Sheet No. 404, October, 1939

Compiled by the Steel Improvement and Forge Co., Cleveland, Ohio

MACHINERY'S DATA SHEETS 405 and 406

PHYSICAL PROPERTIES AND APPLICATIONS OF FORGING METALS—5

S A E No.	Average Physical Properties*					General Applications
	Reduction in Area, Per Cent		Brinell Hardness Number		Machin- ability Rating†	
	Heat- Treated	An- nealed	Heat- Treated	An- nealed		
Corrosion-Resisting Steels (Stainless Type)						
410	28	60 *	387	149	65	410 A straight-chrome stainless iron for general service requiring economy. Desirable where corrosive conditions are not extreme. Best results when surface is highly polished.
416	35	60	301	149	85	416 Free-machining grade of 410 type. Has better non-galling and non-seizing properties than 410.
420	..	..	495	...	..	420 Greatly increased hardness, as compared with type 410. Used where a hard keen edge with corrosion-resisting properties is required. Must be used in the fully hardened state for corrosion-resisting properties.
430	..	70	...	167	..	430 Higher chromium content than Type 410, with better corrosion-resisting properties. Cannot be hardened by heat-treatment.
440	..	..	578	...	..	440 Higher chromium content than Type 420, with greater hardness and corrosion-resisting properties. Must be used in the fully hardened state for corrosion-resisting properties.
302	..	60	...	163	50	302 Chrome-nickel stainless steel with greater corrosion resistance than straight-chromium steels. An austenitic steel that cannot be hardened by heat-treatment. Known as 18-8.
303	..	60	...	146	70	303 The free-machining grade of the 18-8 steels. Has improved non-galling and non-seizing properties.
304	..	60	...	163	50	304 Same as Type 302, except with lower carbon content; for use where welding is necessary.
502	..	70	...	143	65	502 A semi-stainless steel for use under moderate corrosive conditions at high temperatures where non-creep properties are desirable.

*The physical properties given in this table for heat-treated metals are obtained by tempering at 800 degrees F. after a suitable quench. Carbon steels are quenched in water, the other steels being quenched in oil. †Machinability is based on rating of 100 for SAE 1020 carbon steel.

*The physical properties given in this table for heat-treated metals are obtained by tempering at 800 degrees F. after a suitable quench. Carbon steels are quenched in water, the other steels being quenched in oil. †Machinability is based on rating of 100 for S A E 1020 carbon steel.

MACHINERY'S Data Sheet No. 405, November, 1939

Compiled by the Steel Improvement
and Forge Co., Cleveland, Ohio

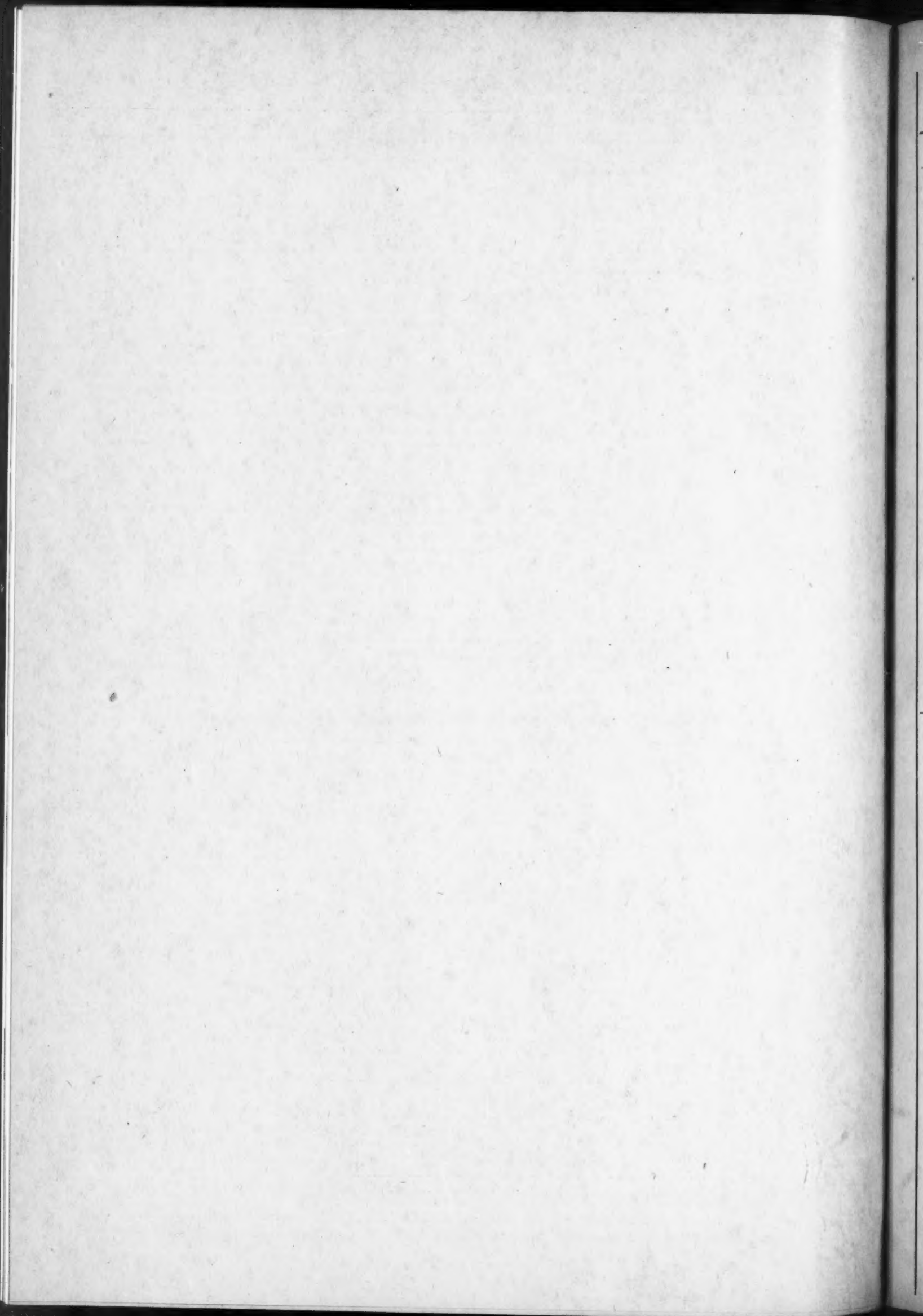
PHYSICAL PROPERTIES AND APPLICATIONS OF FORGING METALS—6

S A E No.	Approximate Composition, Per Cent					Average Physical Properties*					
	Carbon	Nickel	Chromium	Molybdenum	Vanadium	Tensile Strength, Pounds per Sq. In.		Yield Point, Pounds per Sq. In.		Elongation in Two Inches, Per Cent	
						Heat- Treated	Annealed	Heat- Treated	Annealed	Heat- Treated	Annealed
High-Carbon Alloy Steels											
T1340	0.40	....	....	1.7 (Man- ganese)	....	175,000	90,000	150,000	62,000	12	26
2340	0.40	3.50	....	....	....	175,000	90,000	150,000	62,000	14	25
2345	0.45	3.50	....	....	....	185,000	95,000	155,000	66,000	13	24
3140	0.40	1.25	0.60	....	....	180,000	85,000	155,000	62,000	14	25
3150	0.50	1.25	0.60	....	....	190,000	97,000	160,000	66,000	13	24
3240	0.40	1.75	1.10	....	....	198,000	99,000	180,000	70,000	13	22
3250	0.50	1.75	1.10	....	....	220,000	105,000	196,000	75,000	12	21
3340	0.40	3.50	1.50	....	....	205,000	98,000	180,000	72,000	12	23
3450	0.50	3.00	0.80	....	....	200,000	98,000	175,000	72,000	12	21
4140	0.40	....	0.95	0.20	....	180,000	85,000	160,000	62,000	12	26
4150	0.50	....	0.95	0.20	....	200,000	95,000	166,000	66,000	10	24
4340	0.40	1.75	0.65	0.35	....	220,000	105,000	200,000	81,000	10	20
4345	0.45	1.75	0.75	0.20	....	215,000	100,000	198,000	80,000	10	20
6140	0.40	....	0.95	....	0.18	180,000	90,000	160,000	62,000	12	26
6150	0.50	....	0.95	....	0.18	190,000	95,000	170,000	66,000	11	24
Spring Steels											
1095	1.00	....	....	....	....	190,000	95,000	125,000	60,000	11	20
9260	0.60	....	2.0 (Silicon)	0.7 (Man- ganese)	....	220,000	96,000	185,000	66,000	10	17
*The physical properties given in this table for heat-treated metals are obtained by tempering at 800 degrees F. after a suitable quench. Carbon steels are quenched in water, the other steels being quenched in oil.											

*The physical properties given in this table for heat-treated metals are obtained by tempering at 800 degrees F. after a suitable quench. Carbon steels are quenched in water, the other steels being quenched in oil.

MACHINERY'S Data Sheet No. 406, November, 1939

Compiled by the Steel Improvement
and Forge Co., Cleveland, Ohio



MACHINERY'S DATA SHEETS 407 and 408

PHYSICAL PROPERTIES AND APPLICATIONS OF FORGING METALS—7

S A E No.	Average Physical Properties*				Machin- ability Rating†	General Applications
	Reduction in Area, Per Cent		Brinell Hardness Number			
	Heat- Treated	An- nealed	Heat- Treated	An- nealed		
High-Carbon Alloy Steels						
T1340	40	62	352	174	88	T1340 Has better physical properties and machining qualities than plain carbon steels of similar carbon content.
2340	50	62	388	163	80	2340 } Offer a fine combination of hardness and toughness when heat-treated. Desirable for long shafts and other parts requiring minimum warpage.
2345	50	62	401	174	78	
3140	50	62	388	163	78	3140 } Have good physical properties and hardness for an economical alloy steel. 3150 } Used considerably for small and medium-sized forgings of all kinds.
3150	46	58	401	174	75	
3240	40	56	401	187	72	3240 } For service conditions beyond the range of SAE 3140 and 3150. Increased hardness penetration is desirable on large sections.
3250	38	55	415	207	68	
3340	50	68	375	212	60	3340 } For heat-treated forged parts requiring hardness and resistance to severe stresses. Requires careful handling to obtain maximum properties.
3450	48	62	375	217	65	
4140	50	70	388	187	85	4340 } Alloy steels offering a fine combination of hardness, toughness, and resistance to shock and impact. Excellent for heavy-duty service. Machinable up to a hardness of about 450 Brinell.
4150	46	64	415	207	80	
4340	40	60	444	235	60	4345 } Interchangeable with SAE 2300, 3100, and 4100 series of similar carbon content. Particularly desirable for pieces that are difficult to heat-treat due to variation in sections.
4345	40	60	444	235	60	
6140	46	65	401	179	75	6140 } 6150 }
6150	42	60	415	197	72	
Spring Steels						
1095	32	48	388	201	60	1095 For service requiring a high degree of resilience, as in springs. Suitable for moderate conditions.
9260	32	50	444	217	60	9260 Similar purpose to SAE 1095, used where greater strength and elasticity are necessary.
*The physical properties given in this table for heat-treated metals are obtained by tempering at 800 degrees F. after a suitable quench. Carbon steels are quenched in water, the other steels being quenched in oil. †Machinability is based on rating of 100 for SAE 1020 carbon steel.						

*The physical properties given in this table for heat-treated metals are obtained by tempering at 800 degrees F. after a suitable quench. Carbon steels are quenched in water, the other steels being quenched in oil. †Machinability is based on rating of 100 for S A E 1020 carbon steel.

MACHINERY'S Data Sheet No. 407, December, 1939

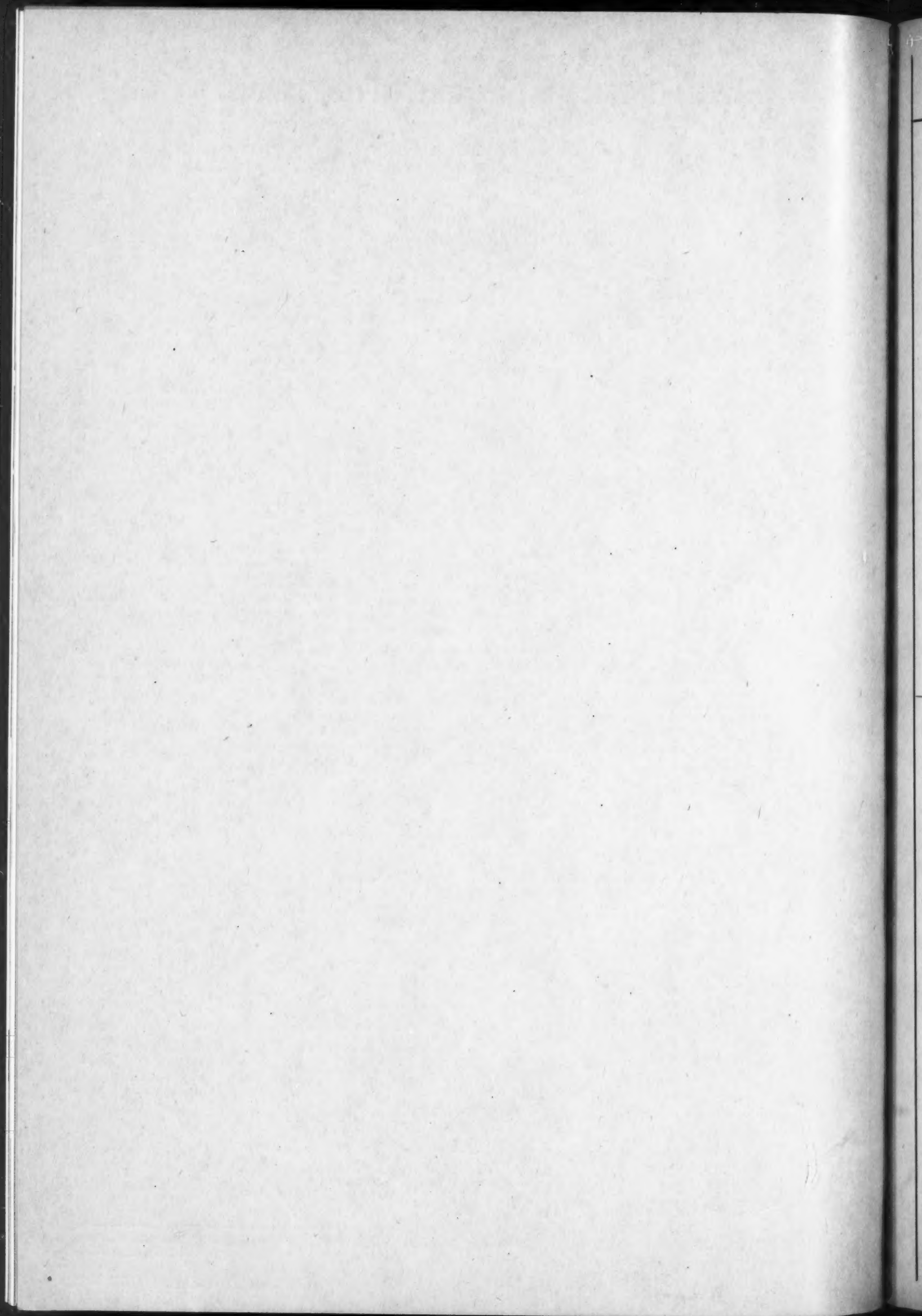
Compiled by the Steel Improvement and Forge Co., Cleveland, Ohio

PHYSICAL PROPERTIES AND APPLICATIONS OF FORGING METALS—8

Kind of Metal	Approximate Composition, Per Cent			Average Physical Properties			
	Copper	Zinc	Other Elements	Tensile Strength, Pounds per Sq. In.		Yield Point, Pounds per Sq. In.	
				Min.	Max.	Min.	Max.
Non-Ferrous Metals							
Copper	99.0	....	.....	32,000	36,000	.....	.....
Forging Brass	60.0	38.0	2.0 Lead	50,000	65,000	25,000	55,000
Muntz Metal	59.0	41.0	.....	50,000	65,000	25,000	55,000
Tobin Bronze	59.0	38.0	2.0 Lead and 1.0 Tin.....	55,000	70,000	25,000	55,000
Manganese Bronze ...	57.0	40.1	1.4 Iron and 1.4 Tin.....	65,000	90,000	.....	.....
Silicon Bronze	96.0	....	1.0 Manganese and 3.0 Silicon.	55,000	100,000	25,000	80,000
Nickel Al. Bronze	92.0	....	4.0 Nickel and 4.0 Aluminum..	55,000	100,000	25,000	80,000
Aluminum Bronze ...	92.0	....	8.0 Aluminum	60,000	120,000	30,000	60,000
Beryllium Copper ...	97.4	....	2.2 Beryllium and 0.4 Nickel..	70,000	115,000	30,000	100,000
Monel Metal	33.0	....	67.0 Nickel	80,000	110,000	60,000	85,000
Nickel .....	....	....	99.0 Nickel	75,000	105,000	50,000	80,000
Iron							
Wrought Iron				40,000	50,000	25,000	35,000
Ingot Iron				38,000	44,000	18,000	22,000

MACHINERY'S Data Sheet No. 408, December, 1939

Compiled by the Steel Improvement and Forge Co., Cleveland, Ohio



MACHINERY'S DATA SHEETS 409 and 410

PHYSICAL PROPERTIES AND APPLICATIONS OF FORGING METALS—9

Kind of Metal	Physical Properties					General Applications
	Elongation in Two Inches, Per Cent		Rockwell B Hardness Number		Machinability Rating	
	Min.	Max.	Min.	Max.		
Non-Ferrous Metals						
Copper .....	..	..	..	..	125	<i>Copper</i> —Considerable use in forgings for electrical parts.
Forging Brass	15	35	68	94	200	<i>Forging Brass</i> —The most popular forging brass for general purposes. Forges well and machines easily.
Muntz Metal	15	40	68	94	75	<i>Tobin Bronze</i> —Similar to forging brass with an addition of about 1 per cent tin. Somewhat better physical properties than forging brass.
Tobin Bronze	15	40	68	94	100	<i>Manganese Bronze</i> —Strongest of the yellow brasses, tough and hard. It is fairly difficult to forge and machine, as compared to forging brass.
Manganese Bronze	15	45	..	..	80	<i>Silicon Bronze</i> —A true bronze without an appreciable amount of zinc. Stronger than any of the brasses, with greater corrosion-resisting properties for many purposes. Difficult to forge and machine.
Silicon Bronze	30	80	40	92	75	<i>Nickel-Aluminum Bronze and Aluminum Bronze</i> —Have good strength, corrosion resistance and wearing properties.
Nickel Al. Bronze	30	80	40	92	75	<i>Beryllium Copper</i> —Has good strength and resistance to fatigue. Can be heat-treated to a Brinell hardness of over 350. Has better electrical conductivity than other high-strength metals or alloys.
Aluminum Bronze	4	60	30	99	75	<i>Monel Metal and Nickel</i> —Their high strength, toughness, and corrosion-resisting properties over a wide range of conditions make these metals ideal for many purposes.
Beryllium Copper	5	45	Brinell Hardness No.		..	
Monel Metal	20	40	150	170	50	
Nickel	20	40	150	170	50	
Iron						
Wrought Iron .....	..	..	..	...	..	<i>Wrought Iron</i> —An economical iron for many uses, such as boiler parts, ornamental iron pieces, and other parts subjected to some atmospheric corrosion. Does not harden.
Ingot Iron .....	..	..	70	101	75	<i>Ingot Iron</i> —For mild corrosion-resisting service, and for many purposes where a very soft ductile metal with fairly good properties is desired. Does not harden.

MACHINERY'S Data Sheet No. 409, January, 1940

Compiled by the Steel Improvement and Forge Co., Cleveland, Ohio

DIMENSIONS OF WELDED AND SEAMLESS STEEL PIPE (IN INCHES)

Nominal Pipe Size	Outside Diameter	Nominal Wall Thicknesses for Schedule Numbers									
		Schedule 10	Schedule 20	Schedule 30	Schedule 40	Schedule 60	Schedule 80	Schedule 100	Schedule 120	Schedule 140	Schedule 160
1/8	0.405	.....	.....	.....	0.068	.....	0.095	.....	.....	.....	.....
1/4	0.540	.....	.....	.....	0.088	.....	0.119	.....	.....	.....	.....
3/8	0.675	.....	.....	.....	0.091	.....	0.126	.....	.....	.....	.....
1/2	0.840	.....	.....	.....	0.109	.....	0.147	.....	.....	.....	0.187
3/4	1.050	.....	.....	.....	0.113	.....	0.154	.....	.....	.....	0.218
1	1.315	.....	.....	.....	0.133	.....	0.179	.....	.....	.....	0.250
1 1/4	1.660	.....	.....	.....	0.140	.....	0.191	.....	.....	.....	0.250
1 1/2	1.900	.....	.....	.....	0.145	.....	0.200	.....	.....	.....	0.281
2	2.375	.....	.....	.....	0.154	.....	0.218	.....	.....	.....	0.343
2 1/2	2.875	.....	.....	.....	0.203	.....	0.276	.....	.....	.....	0.375
3	3.5	.....	.....	.....	0.216	.....	0.300	.....	.....	.....	0.437
3 1/2	4.0	.....	.....	.....	0.226	.....	0.318	.....	.....	.....	.....
4	4.5	.....	.....	.....	0.237	.....	0.337	.....	0.437	.....	0.531
5	5.563	.....	.....	.....	0.258	.....	0.375	.....	0.500	.....	0.625
6	6.625	.....	.....	.....	0.280	.....	0.432	.....	0.562	.....	0.718
8	8.625	.....	0.250	0.277	0.322	0.406	0.500	0.593	0.718	0.812	0.906
10	10.75	.....	0.250	0.307	0.365	0.500	0.593	0.718	0.843	1.000	1.125
12	12.75	.....	0.250	0.330	0.406	0.562	0.687	0.843	1.000	1.125	1.312
14 O.D.	14.0	0.250	0.312	0.375	0.437	0.593	0.750	0.937	1.062	1.250	1.406
16 O.D.	16.0	0.250	0.312	0.375	0.500	0.656	0.843	1.031	1.218	1.437	1.562
18 O.D.	18.0	0.250	0.312	0.437	0.562	0.718	0.937	1.156	1.343	1.562	1.750
20 O.D.	20.0	0.250	0.375	0.500	0.593	0.812	1.031	1.250	1.500	1.750	1.937
24 O.D.	24.0	0.250	0.375	0.562	0.687	0.937	1.218	1.500	1.750	2.062	2.312
30 O.D.	30.0	0.312	0.500	0.625	.....	.....	.....	.....	.....	.....	.....

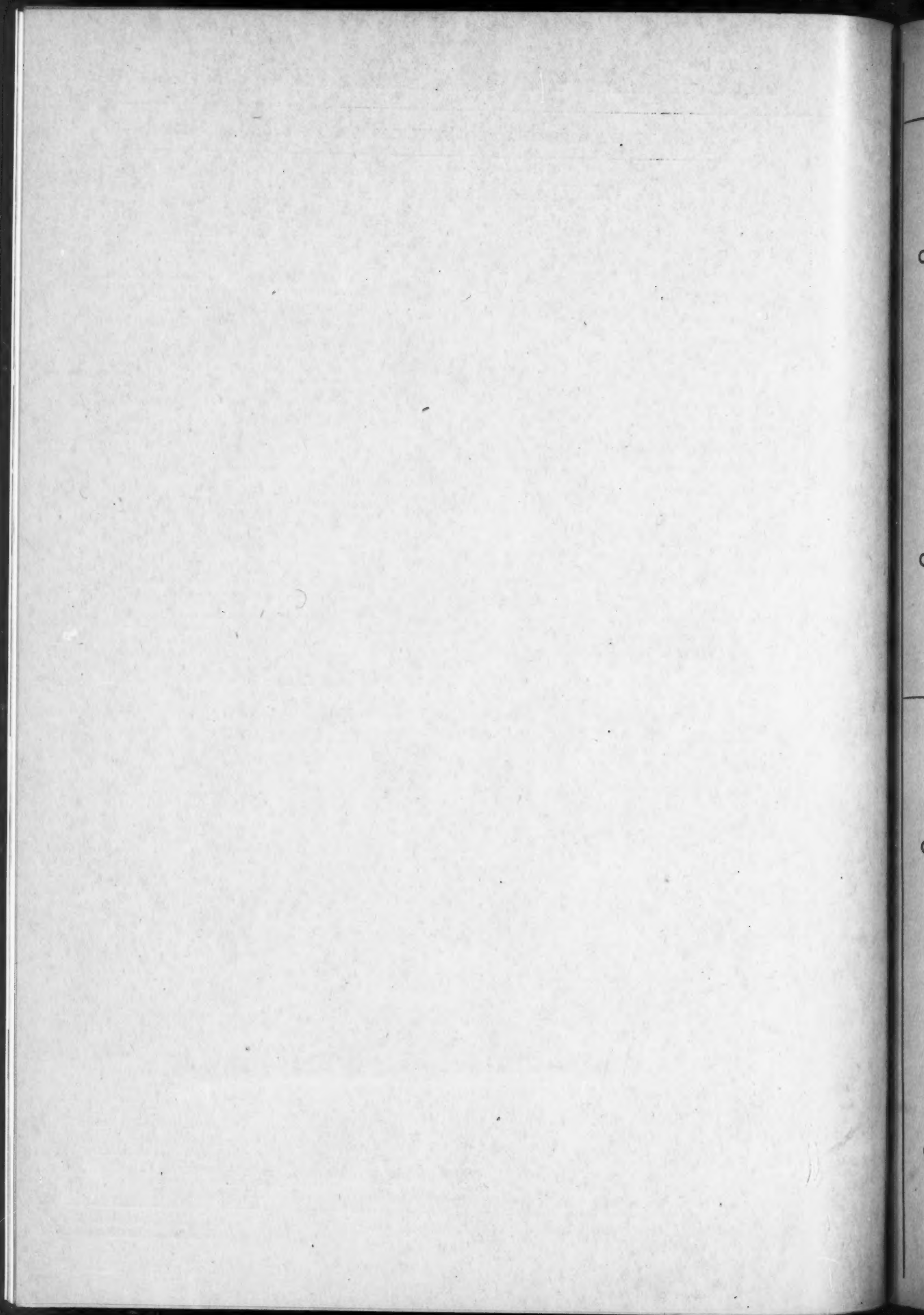
Thicknesses shown in bold face type in Schedules 30 and 40 are identical with thicknesses for "standard weight" pipe in the former standard; those in Schedules 60 and 80 are identical with thicknesses for "extra strong" pipe in the former standard.

The Schedule numbers indicate approximate values of the expression $\frac{1000 \times \text{Pressure in pounds}}{\text{Allowable stress, pounds per square inch}}$

The decimal thicknesses listed represent average wall dimensions.

MACHINERY'S Data Sheet No. 410, January, 1940

Specifications Approved by the American Standards Association



SINGLE-POINT CUTTING TOOLS*—1

Tool Elements

Size—the size of a tool of square or rectangular section is expressed by giving, in the order named, the width and height of shank, and the total tool length, in inches, such as 3/4 by 1 1/2 by 12 inches. The same method of designation is used for tool bit holders, to which is added the size of the bits.

Shank—that part of the tool on one end of which the point is formed or the tip or bit is supported. (See Figs. 1, 2, and 3.) The shank, in turn, is supported on the toolpost of the machine.

Base—that surface of the shank which bears against the support and takes the tangential pressure of the cut.

Heel—the edge between the base and the flank immediately below the face.

Face—that surface on which the chip impinges as it is cut from the work.

Point—that part of the tool which is shaped to produce the cutting edges and face.

Cutting Edge—that portion of the face edge along which the chip is separated from the work. The cutting edge consists usually of the side cutting edge, the nose radius, and the end cutting edge. (See Figs. 1 and 2 of this sheet and Fig. 5 of Data Sheet No. 412.)

Nose—the curve at the juncture of the side and end cutting edges.

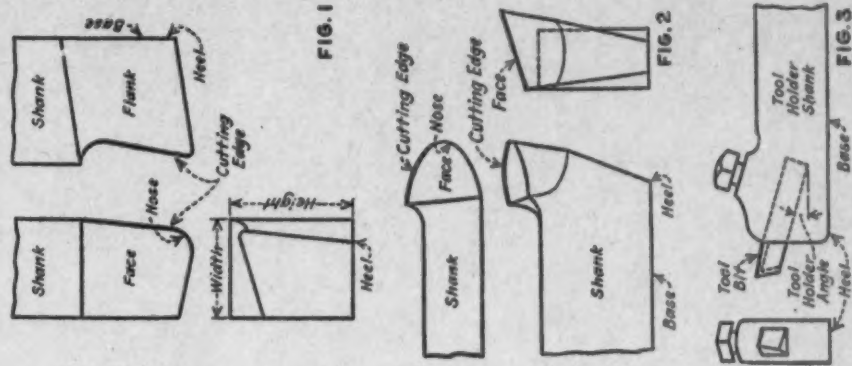
Shape—the contour of the face when viewed in a direction at right angles to the base.

Flank—the surface or surfaces below and adjacent to the cutting edge, Fig. 1.

Neck—an extension of the shank of reduced sectional area. A relatively small point, as required in boring, is sometimes attached to the shank by a neck, Fig. 4, Data Sheet No. 412.

Flat—the straight portion of the cutting edge intended to produce a smooth, machined surface, Fig. 5, Data Sheet No. 412.

Chip Breaker or Control—an irregularity in the face of a tool or a separate piece fastened to the tool or tool-holder to cause the chip to break into short sections or curl, Fig. 6, Data Sheet No. 412.



MACHINERY'S Data Sheet No. 411, February, 1940

SINGLE-POINT CUTTING TOOLS*—2

Ground Tool—one in which the point is formed on the end of a bar (shank) of tool steel by grinding.

Forged Tool—one in which the point is forged roughly to shape on the end of a bar (shank) of tool steel before hardening and grinding.

Tip—the portion of a tool with a tip of cutting material permanently attached to a shank of non-cutting material.

Curved Cutting Edge Tool—one having variable side cutting-edge angles, Fig. 2, Data Sheet No. 411.

Raised Face Tool—one having its face above the top of the shank.

Bit Tool—one in which small parts of the tool materials, of square, rectangular, or other section, or tools forged to special shapes, are held in the end of a holder.

Tool-Holder—a tool shank designed to hold a removable point or tool bit.

Tool Bit—a relatively small piece of cutting material, clamped in a tool shank or holder in such a way that it can readily be removed and replaced.

Straight Tool—one having the point on the forward end of a straight shank, Fig. 5.

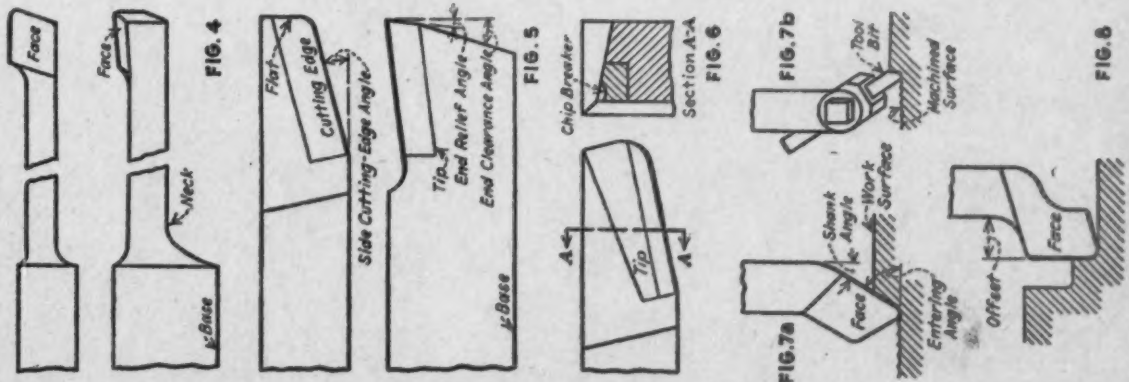
Bent Tool—one having the point bent to the left or right, Figs. 7a and 7b, to make its operation more convenient. Left-bent and right-bent tools have the point bent to the left and right, respectively, when looking at them from the point end with the face upward and the shank pointing away.

Offset Tool—one having the point at either side of, but parallel to, the shank. A right offset tool has the point offset to the right of the shank when looking at the tool from the point, with the face upward and the shank pointing away.

Right-Offset Tool—one which when viewed from the point end of the tool, with the face up, has the cutting edge on the right side, Figs. 4, 7a, and 7b. When used in a lathe, the cutting edge is on the left side, and fed from right to left.

Left-Offset Tool—one having the cutting edge on the left when looking at the point end with the face upward, Figs. 5, 6, and 8.

End-Offset Tool—one having its principal cutting edge on the end.



MACHINERY'S Data Sheet No. 412, February, 1940

MACHINERY, February, 1940

*Terminology and definitions for single-point cutting tools for lathes, planers, shapers, turret lathes, boring mills, etc., approved by the American Standards Association, January, 1939.

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SINGLE-POINT CUTTING TOOLS*—3

Tool-Holder Angle—that angle between the bottom of the bit slot and the base of the tool-holder shank, Fig. 3, Data Sheet No. 411, February, 1940.

Shank Angle—the angle by which the point of a bent tool deviates from the straight portion of the shank, Fig. 12.

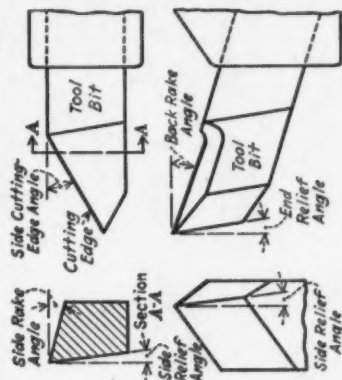


FIG. 9



FIG. 10

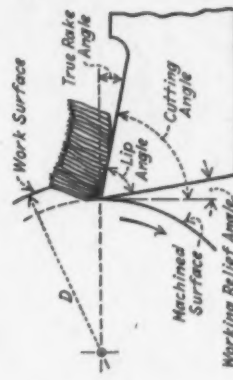


FIG. 11

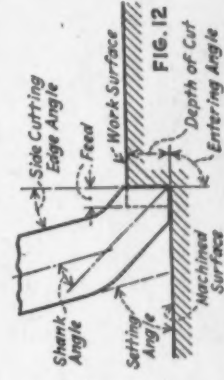


FIG. 12

MACHINERY'S Data Sheet No. 413, March, 1940

SINGLE-POINT CUTTING TOOLS*—4

Working Angles

Working Angles—The working angles are those angles between tool and work that depend not only on the shape of the tool, but also on its position with respect to the work, Fig. 11, Data Sheet No. 413.

Setting Angle—The setting angle is the angle made by the straight portion of the shank of a tool with the finished surface of the work, Fig. 12, Data Sheet No. 413.

Entering Angle—The entering angle is the angle that the side cutting edge of a tool makes with the plane of the finished surface of the work, Figs. 7a and 12, Data Sheets Nos. 412, February, 1940, and 413.

True Rake Angle—The true rake angle (or "top rake") under actual cutting conditions is the actual slope of the tool face toward the base from the active cutting edge in the direction of chip flow, Fig. 11, Data Sheet No. 413. It is a combination of the back rake and side rake angles, and varies with the setting of the tool and with the feed and depth of cut.

Cutting Angle—The cutting angle is the angle between the face of the tool and a tangent to the machined surface at the point of action. It equals 90 degrees minus the true rake angle, Fig. 11, Data Sheet No. 413.

Working Relief Angle—The working relief angle is the angle between the ground flank of the tool and a line tangent to the machined surface passing through the active cutting edge, Fig. 11, Data Sheet No. 413.

Working-End Cutting-Edge Angle—The working-end cutting-edge angle is the angle between the straight-end cutting edge and a plane tangent to the machined surface at the point of cutting.

Lip Angle—The lip angle is the included angle of the tool material between the face and the ground flank measured in a plane at right angles to the cutting edge. When measured in a plane perpendicular to the cutting edge at the end of the tool, it is called the end lip angle. When measured at the point of chip flow, it is called the true lip angle, Fig. 11, Data Sheet No. 413.

General Terms

Cutting Speed—The cutting speed is the peripheral or surface speed of the work with respect to the tool. In turning, it is usually measured on the uncured or work surface of the work ahead of the tool.

Depth of Cut—The depth of cut is the distance between the bottom of the cut and the uncured surface of the work, measured in a direction at right angles to the machined surface of the work, Fig. 12, Data Sheet No. 413.

Feed—The feed is the relative amount of motion of the tool into the work for each revolution, stroke, or unit of time, Fig. 12, Data Sheet No. 413.

Machined Surface—The machined surface is the surface left by the cutting tool.

Work Surface—The work surface refers to the surface to be machined.

Symbols

Recommended Symbols—A recommended system of symbols for brevity in catalogues, purchase orders, etc., follows:

- RC-S Right-cut, single-point tool with straight shank, Fig. 1, Data Sheet No. 411, February, 1940.
- LC-S Left-cut, single-point tool with straight shank, Fig. 5, Data Sheet No. 412, February, 1940.
- RC-RB Right-cut, single-point tool with right-bent shank, Fig. 7b, Data Sheet No. 413.
- LC-RB Left-cut, single-point tool with right-bent shank.
- LC-LB Left-cut, single-point tool with left-bent shank.
- RC-RO Right-cut, single-point tool with right offset shank.
- RC-LO Right-cut, single-point tool with left offset shank.
- LC-RO Left-cut, single-point tool with right offset shank.
- LC-LO Left-cut, single-point tool with left offset shank, Fig. 8, Data Sheet 412.

MACHINERY'S Data Sheet No. 414, March, 1940

*Terminology and definitions for single-point cutting tools for lathes, planers, shapers, turret lathes, boring mills, etc., approved by the American Standards Association, January, 1939.

THE SELECTION OF GRINDING WHEELS—1

The following describes in a general way the factors affecting the selection of the various constituents of a grinding wheel; namely, the abrasive, grain size, grade, structure, and type of bond. It should be understood, however, that the rules and conditions set down are quite flexible, and in a few instances exceptions occur.

1. The Abrasive

Use aluminum-oxide* grinding wheels for materials of high tensile strength	Carbon steels Alloy steels High-speed steel Annealed malleable iron Wrought iron Tough bronzes, etc.
Use silicon-carbide* grinding wheels for materials of low tensile strength	Gray iron Chilled iron Brass and soft bronze Aluminum and copper Marble and other stone Rubber Leather Very hard alloys Cemented carbides

A. Physical properties of material to be ground

*Aluminum oxide is designated by the Norton Co. as "Alundum" and silicon carbide as "Crysolon."

2. The Grain Size

A. Amount of material to be removed.	Coarse wheel for fast cutting*
B. Finish desired	Fine grain for fine finish
C. Physical properties of material to be ground	Coarse grain for soft ductile materials and fine grain for hard brittle materials

3. The Grade

A. Physical properties of material to be ground	Hard wheels for soft materials. Soft wheels for hard materials
B. Area of contact	The smaller the area of contact the harder the wheel should be
C. Wheel speed and work speed	The higher the work speed with relation to wheel speed, the harder the grade should be and vice versa
D. Condition of machine	The presence of vibration and worn master parts of the machine usually call for a harder wheel than would be required on a machine in good condition

*Exception: Very hard materials where depth of grain penetration is small

MACHINERY'S Data Sheet No. 415, April, 1940

Compiled by the Norton Co.
Worcester, Mass.

THE SELECTION OF GRINDING WHEELS—2

4. The Structure

Structure (grain spacing) refers to the number of cutting edges per unit area of wheel face, as well as the number and size of voids between the abrasive grains.

A. Physical properties of material

{ Soft, tough, and ductile materials require a wheel with a wide spacing of abrasive grains. Hard and brittle materials require a wheel having a close spacing of abrasive grains* }

B. Finish required

{ Fine finish requires the use of wheels having closer spacing of abrasive particles than would be needed for medium or coarse finish }

C. Nature of operation

- (a) Snagging and other operations with flexible application of pressure require wide grain spacing
- (b) Surfacing operations require wide grain spacing
- (c) Cylindrical, centerless, and tool and cutter grinding are usually best performed with wheels of medium grain spacing
- (e) Heavy pressures which tend to destroy the form of shaped wheels call for wheels with close grain spacing

*Exception: Cemented Carbides

5. The Bond

The vitrified type of bond is most generally used. However, in some instances, operating and performance requirements make the selection of other types advantageous or essential.

A. Dimensions of wheel

{ Thin cutting-off wheels and others subjected to deflection strains require resinoid, shellac, or rubber bonds. Solid wheels of very large diameters require silicate bond }

B. Operating speed

{ Vitrified wheels are usually best for speeds below 6500 surface feet per minute; resinoid, shellac, or rubber wheels are best for speeds above 6500 surface feet per minute }

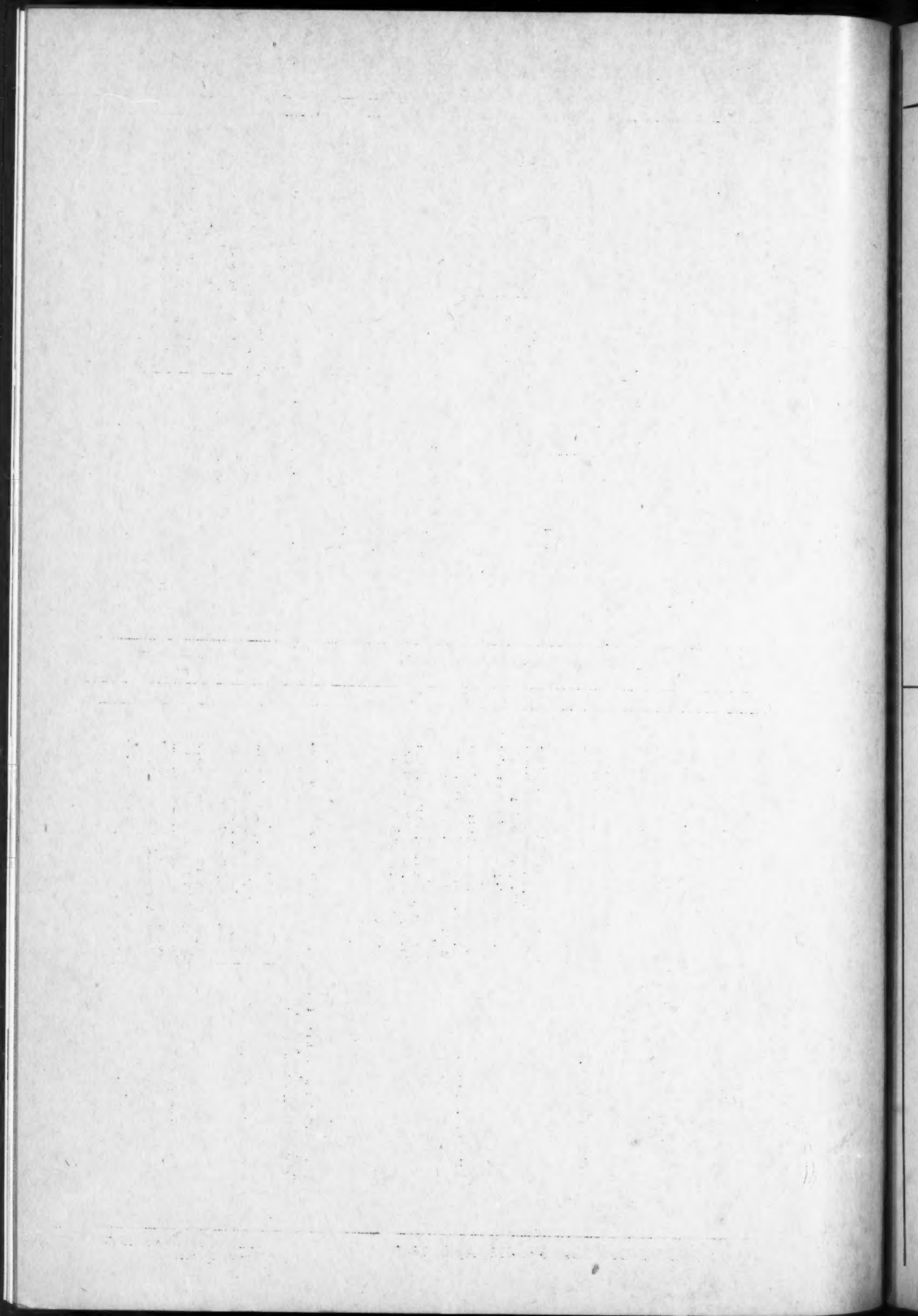
C. Finish required

{ Resinoid, rubber, or shellac wheels are generally best for high finish }

MACHINERY'S Data Sheet No. 416, April, 1940

Compiled by the Norton Co.
Worcester, Mass.

MACHINERY, April, 1940



MACHINERY'S DATA SHEETS 417 and 418

RECOMMENDED WELDING METHODS, FLAME ADJUSTMENTS, WELDING RODS, AND FLUXES—1

Metal or Alloy	Welding Method	Flame Adjustment	Welding Rod*	Flux*
Aluminum	Fusion Weld	Carburizing	No. 23 Aluminum	Aluminum
Brass	Fusion Weld	Oxidizing	No. 25 M Bronze	Brass
	Bronze Weld	Slightly Oxidizing	No. 21 H.S. Bronze	Cromaloy
Bronze	Fusion Weld	Oxidizing	No. 25 M Bronze	Brass
	Fusion Weld	Oxidizing	No. 25 M Bronze	Brass
	Bronze Weld	Slightly Oxidizing	No. 25 M Bronze	Brass
Cast Iron, Gray	Fusion Weld	Neutral	No. 9 Cast Iron	Ferro
	Bronze Weld	Slightly Oxidizing	No. 25 M Bronze	Brass
Cast Iron, Malleable	Bronze Weld	Slightly Oxidizing	No. 25 M Bronze	Brass
Cast Iron Pipe, Gray	Bronze Weld	Slightly Oxidizing	No. 25 M Bronze	Brass
Cast Iron Pipe, Chromium-Nickel	Fusion Weld	Neutral	No. 9 Cast Iron	Ferro
Chromium-Nickel Steel Castings	Bronze Weld	Slightly Oxidizing	Same Composition as Base Metal	Brass
Chromium-Nickel Steel (18-8)	Fusion Weld	Neutral	Same Composition as Base Metal	Cromaloy
Chromium-Nickel Steel (24-12)	Fusion Weld	Neutral	No. 28 Columbium-Bearing 18-8 Stainless Steel	Cromaloy
Chromium-Steel Castings	Fusion Weld	Neutral	Same Composition as Base Metal	Cromaloy
Chromium-Steel (4 to 6 Per Cent)	Fusion Weld	Neutral	Same Composition as Base Metal	Cromaloy
Chromium-Iron	Fusion Weld	Neutral	No. 28 Columbium-Bearing 18-8 Stainless Steel	Cromaloy
Copper	Fusion Weld	Neutral	Same Composition as Base Metal	None
Copper Pipe	Fusion Weld	Slightly Oxidizing	No. 19 Cupro	Brass
	Fusion Weld	Neutral	No. 19 Cupro	None

*Fluxes and numbered welding rods are "Oxweld" designations.

MACHINERY'S Data Sheet No. 417, May, 1940

Compiled by The Linde Air Products Company

RECOMMENDED WELDING METHODS, FLAME ADJUSTMENTS, WELDING RODS, AND FLUXES—2

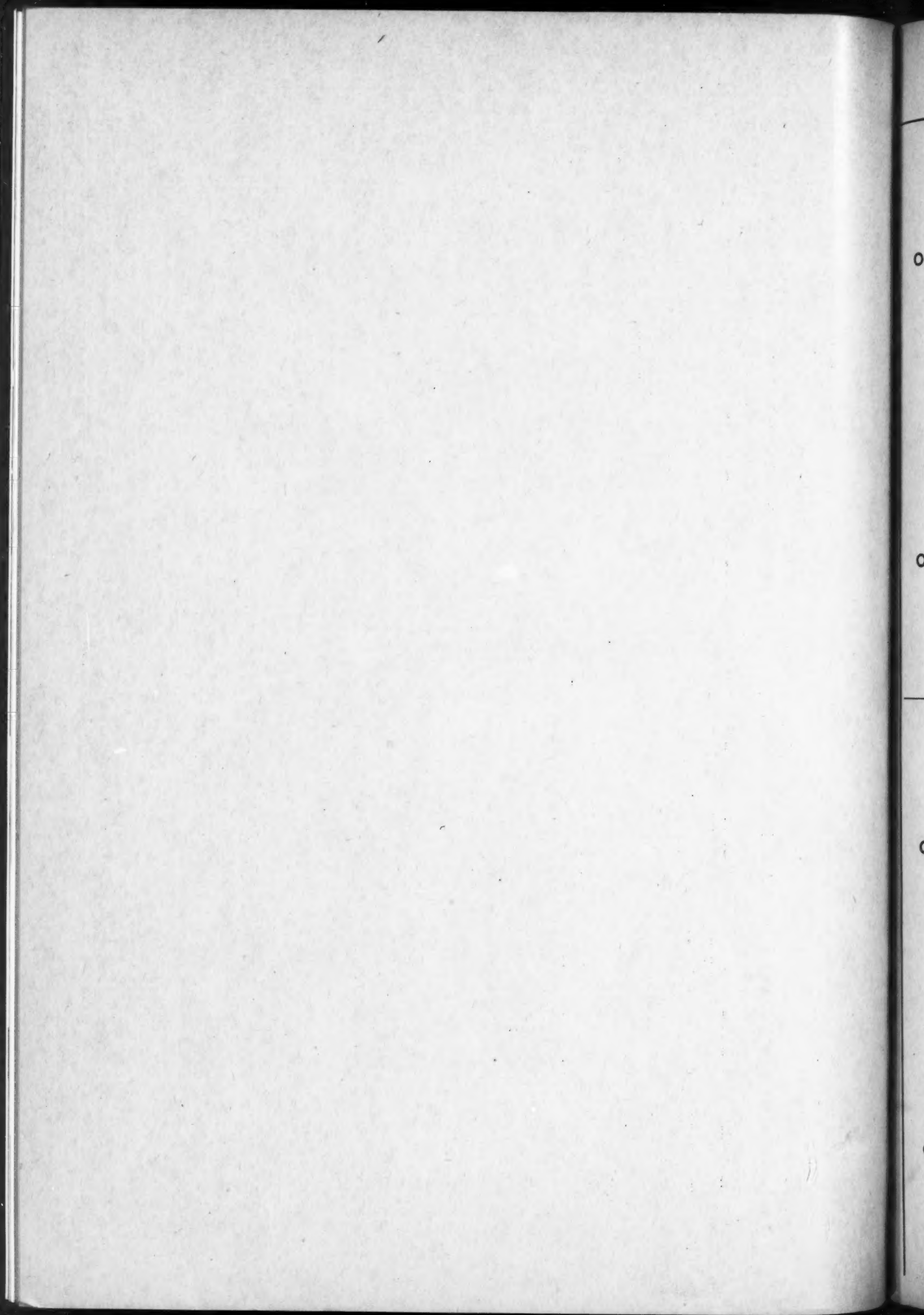
Metal or Alloy	Welding Method	Flame Adjustment	Welding Rod*	Flux*
Copper Pipe (Cont.)	Bronze Weld	Slightly Oxidizing	No. 25 M Bronze	Brass
Cromansil Steel	Fusion Weld	Neutral	No. 1 High-Test Steel (up to 3/16 inch)	None
Everdur	Fusion Weld	Neutral	Manganese-Molybdenum Steel (over 3/16 inch)	Everdur
Galvanized Iron	Fusion Weld	Neutral	No. 26 Everdur Bronze	None
	Bronze Weld	Slightly Oxidizing	No. 7 Drawn Iron	None
High-Carbon Steel	Fusion Weld	Carburizing	No. 1 High-Test Steel	Brass
Lead	Fusion Weld	Carburizing	No. 25 M Bronze	None
Lead Pipe	Fusion Weld	Carburizing	No. 32 C.M.S. Steel	None
Malleable Iron	Fusion Weld	Carburizing	No. 2 High-Carbon Steel	None
Manganese Steel	Fusion Weld	Carburizing	Same Composition as Base Metal	None
Monel Metal	Fusion Weld	Carburizing	Same Composition as Base Metal	None
Nickel	Fusion Weld	Carburizing	No. 25 M Bronze	Brass
Steel, Cast	Fusion Weld	Carburizing	12 Per Cent Manganese Steel	None
Steel Pipe	Fusion Weld	Carburizing	Same Composition as Base Metal	Brass
Steel Plate	Fusion Weld	Carburizing	Same Composition as Base Metal	Brass
Steel Sheet	Fusion Weld	Carburizing	No. 1 High-Test Steel	None
	Fusion Weld	Carburizing	No. 32 C.M.S. Steel	None
	Fusion Weld	Carburizing	No. 7 Drawn Iron	None
	Fusion Weld	Carburizing	No. 1 High-Test Steel	None
	Fusion Weld	Carburizing	No. 32 C.M.S. Steel	None
	Fusion Weld	Carburizing	No. 7 Drawn Iron	None
	Fusion Weld	Carburizing	No. 1 High-Test Steel	None
	Fusion Weld	Carburizing	No. 25 M Bronze	Brass
	Fusion Weld	Carburizing	No. 19 Cupro	None

*Fluxes and numbered welding rods are "Oxweld" designations.

MACHINERY'S Data Sheet No. 418, May, 1940

Compiled by The Linde Air Products Company

MACHINERY, May, 1940



MACHINERY'S DATA SHEETS 421 and 422

RECOMMENDED FEEDS AND SPEEDS FOR MACHINING R-MONEL

DRILLING			
Drill Size, Inches	Feed, Inches	Speed, Feet per Minute	
1/16	0.002	60-75	
3/32	0.0025	60-75	
1/8	0.003	60-75	
3/16	0.0035	60-75	
1/4	0.004	60-75	
5/16	0.0045	60-75	
3/8	0.005	60-75	
1/2	0.006	60-75	
5/8	0.008	60-75	
AUTOMATIC SCREW MACHINE WORK			
Operation	Width of Cut, Inches	Feed, Inches	Speed, Feet per Minute
Box-tool: Roughing	1/32	0.006	100-125
	1/16	0.005	100-125
	1/8	0.004	100-125
Finishing	0.005	0.010	100-125
Cut-off: Circular Tool Straight Tool	1/16 to 1/8	0.001	100-125
Stock under 1/8 Inch Diameter	—	0.0005	100-125
Forming Tool: Circular	1/8 to 1/4 3/8 to 1/2 5/8 to 3/4 1	0.0006 0.0005 0.0004 0.00025	100-125 100-125 100-125 100-125
Balance Turning Tool: Turned Diameter under 5/32 Inch	1/32 1/16	0.006 0.005	100-125 100-125
Turned Diameter over 5/32 Inch	1/32 1/16	0.012 0.010	100-125 100-125

MACHINERY'S Data Sheet No. 421, July, 1940

Compiled by the International
Nickel Co., Inc., New York

SUGGESTED FEEDS AND SPEEDS FOR DRILLING MONEL, NICKEL, AND INCONEL

Monel and Nickel				Inconel				K-Monel (Unhardened)			
Drill Size, Inches	Speed, Feet per Minute	R.P.M.	Feed per Rev., Inches	Drill Size, Inches	Speed, Feet per Minute	R.P.M.	Feed per Rev., Inches	Drill Size, Inches	Speed, Feet per Minute	R.P.M.	Feed per Rev., Inches
1/16	50	3055	0.0015	1/16	40	2445	0.0015	1/16	25	1525	0.001
3/32	50	2100	0.0020	3/32	40	1645	0.0020	3/32	25	1050	0.0015
1/8	50	1525	0.0025	1/8	40	1220	0.0025	1/8	25	765	0.002
3/16	50	1020	0.003	3/16	40	815	0.003	3/16	25	510	0.0025
1/4	60	920	0.0035	1/4	45	685	0.0035	1/4	30	460	0.003
5/16	60	735	0.004	5/16	45	550	0.004	5/16	30	370	0.0035
3/8	60	610	0.0045	3/8	45	460	0.0045	3/8	30	305	0.004
7/16	60	525	0.005	7/16	45	395	0.005	7/16	30	265	0.0045
1/2	60	460	0.0055	1/2	45	345	0.0055	1/2	30	230	0.005
9/16	60	405	0.006	9/16	45	305	0.006	9/16	30	205	0.0055
5/8	60	365	0.007	5/8	45	275	0.007	5/8	30	185	0.006
11/16	60	335	0.008	11/16	45	250	0.008	11/16	30	170	0.0065
3/4	60	305	0.009	3/4	45	230	0.009	3/4	30	155	0.007
13/16	40	190	0.010	13/16	30	140	0.010	13/16	20	95	0.0075
7/8	40	175	0.011	7/8	30	130	0.011	7/8	20	90	0.008
15/16	40	165	0.012	15/16	30	120	0.012	15/16	20	85	0.008
1	40	150	0.013	1	30	115	0.013	1	20	75	0.009
1 1/8	40	135	0.014	1 1/8	30	100	0.014	1 1/8	20	67	0.009
1 1/4	40	120	0.015	1 1/4	30	90	0.015	1 1/4	20	60	0.010
1 3/8	40	115	0.015	1 3/8	30	80	0.015	1 3/8	20	57	0.010
1 1/2	40	102	0.015	1 1/2	30	75	0.015	1 1/2	20	54	0.010
1 5/8	40	100	0.016	1 5/8	30	70	0.016	1 5/8	20	50	0.011
1 3/4	40	85	0.016	1 3/4	30	65	0.016	1 3/4	20	43	0.011
1 7/8	40	80	0.016	1 7/8	30	60	0.016	1 7/8	20	40	0.011
2	40	75	0.016	2	30	57	0.016	2	20	38	0.012
2 1/4	40	65	0.016	2 1/4	30	50	0.016	2 1/4	20	32	0.012
2 1/2	40	60	0.016	2 1/2	30	45	0.016	2 1/2	20	30	0.012
2 3/4	40	55	0.016	2 3/4	30	42	0.016	2 3/4	20	27	0.012
3	40	50	0.016	3	30	38	0.016	3	20	25	0.012

MACHINERY'S Data Sheet No. 422, July, 1940

Compiled by the International
Nickel Co., Inc., New York

MACHINERY, July, 1940

CUTTING FLUIDS FOR MACHINING OPERATIONS*—1

ever, cannot be considered accurately representative of the machinability rating.

The machinability ratings are based on steels in a cold-drawn condition. Metals that have been heat-treated or processed in any way other than by cold-drawing would have different machinability ratings.

Many users prefer hot-rolled steels for some purposes. The relative effect of hot-rolling can be expressed briefly as follows:

(a) In steels containing up to 0.30 per cent carbon, cold-rolled bars have better machinability.

(b) In steels containing from 0.30 to 0.40 per cent carbon, there is little difference in machinability.

(c) In steels containing over 0.40 per cent carbon, the hot-rolled material has markedly superior machinability.

With regard to the Brinell hardness values listed, it should be stated that the range of values given is intended to indicate the most desirable limits for the machinability ratings recorded. In general, these hardness values indicate the commercial practice followed in filling purchase orders for steel.

In generally accepted practice, the limiting value of hardness for normal machinability is about 355 Brinell, although steels up to 500 Brinell are being machined.

The present data sheets, and sheets to follow during coming months, give the findings and recommendations of the Sub-committee on Cutting Fluids of the Society of Automotive Engineers, as reported to the Society at the Production Meeting held in Hartford, Conn., May, 1940. The report is summarized in two tables, one on the machinability rating of metals, as published in the accompanying Data Sheet No. 424; and the other giving cutting fluid recommendations for different operations and for different materials graded according to their machinability, to be published in Data Sheets Nos. 426 and 427 in the September and October numbers of MACHINERY.

The machinability rating table (Data Sheet No. 424) is based upon the turning of SAE 1112 cold-drawn steel at a cutting speed of 180 feet per minute, the machinability being taken as equal to 100. The other metals are listed approximately in the order of their machinability, as compared with SAE 1112. Both ferrous and non-ferrous metals are included in the table. The ferrous metals are grouped in four classes, and the non-ferrous in two classes. The machinability figures are given to the nearest round number for ease of comparison. Brinell hardness numbers are also given for the SAE steels. These hardness figures, how-

*Based on a Report of the Sub-Committee on Cutting Fluids of the Society of Automotive Engineers, Presented by H. L. Moir and O. W. Boston before the Production Meeting of the Society at Hartford, Conn., May 7, 1940

MACHINERY'S Data Sheet No. 423, August, 1940

CUTTING FLUIDS FOR MACHINING OPERATIONS—2

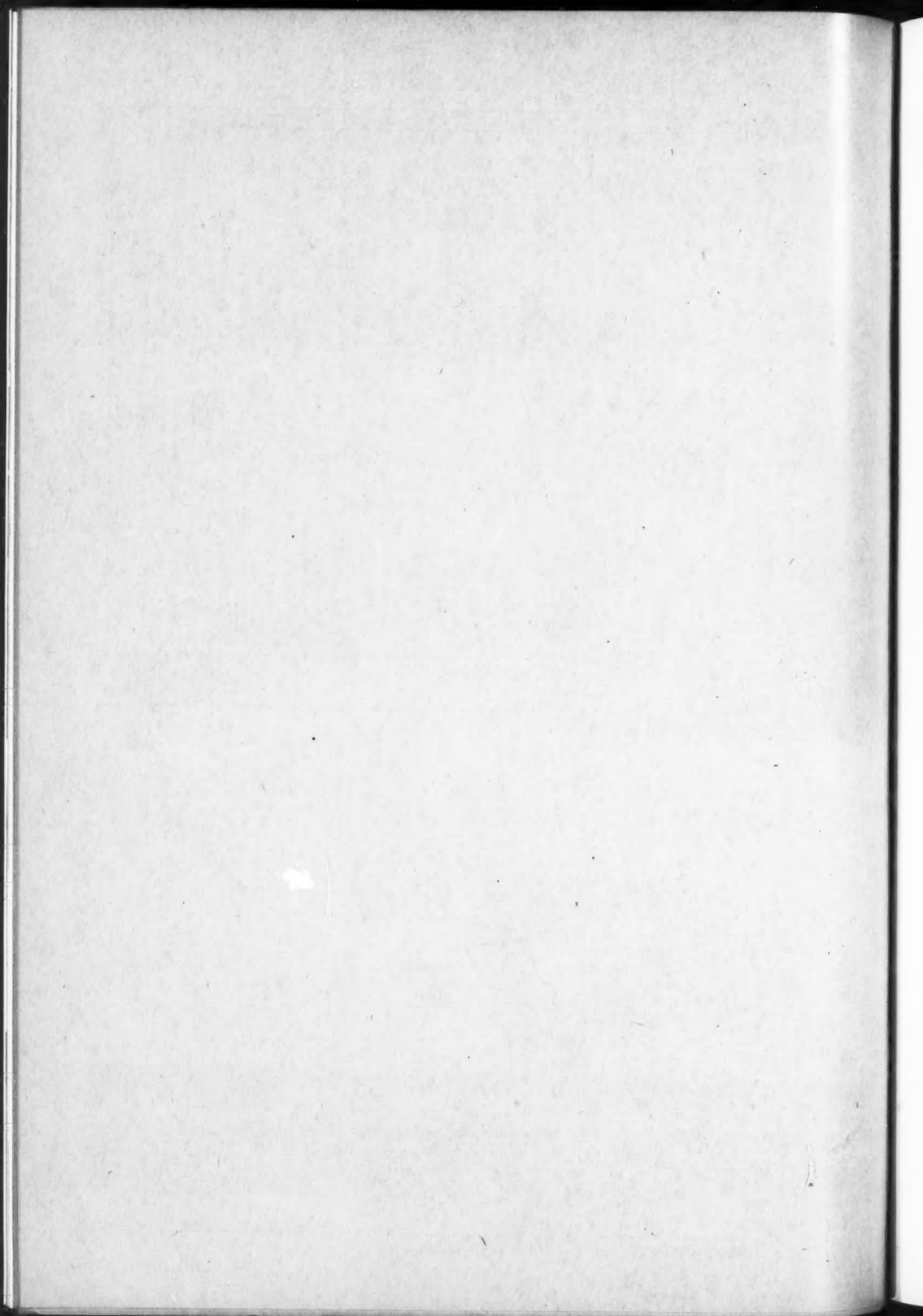
Machinability Rating of Metals

SAE No.	Machinability Value	Brinell Hardness	SAE No.	Machinability Value	Brinell Hardness
Class 1			Class 4		
1112	100	178-228	NI-Resist	30	30
X1112	135	178-228	Stainless 18-8	30	30
1120	80	143-179	Austenitic*	35	35
X1315	85	143-179	Steel, Manganese,		
X1335	70	187-229	Oil-Hardening*		
X1020	75	159-192	Tool Steel, Low Tung-		
4120	70	179-223	sten-Chromium*		
6115	70	179-223	Carbon Tool Steels*		
Mail. Iron	75-150	.....	High-Speed Steel*		
			Steel, High-Carbon,		
			High-Chromium*		
Class 2			Downmetal	100	100
1020	65	134-166	Magnesium and		
1030	70	170-212	Alloys		
1040	60	179-228	Aluminum 11-S	200-500	200-500
X1040	70	179-228	Aluminum 2-S	100-300	100-300
2315	55	174-217	Aluminum 17-S	100-300	100-300
3130*	55	179-217	Brass, Leaded	150	150
3140*	55	187-228	Brass, Yellow	100	100
4130*	65	187-228	Brass, Red	100	100
4615	60	174-217	Bronze, Leaded	100	100
4640*	55	187-235	Bearing	200	200
4815	65	187-228	Zinc		
5120	60	170-212	Gun Metal	60	60
Stainless Iron	60	160-217	Bronze Manganese	40	40
			Copper, Cast	70	70
1010	50	131-170	Copper, Rolled	60	60
1050*	50	179-228	Nickel	20	20
2330*	50	179-217	Monel, Cast	35	35
2340*	50	184-235	Monel, Rolled	45	45
3220	50	179-228	Monel, K	50	50
3230*	45	184-235	Inconel	45	45
4140*	50	184-235	Everdur	60	60
4150*	45	196-235			
5140*	45	187-228			
6130*	50	179-217			
6140*	40	187-228			
T1330*	50	179-217			
T1340*	40	187-228			
9260*	45	196-241			
Ingot Iron	50	101-131			
Wrought Iron	50	101-131			
Stainless 18-8	45	179-212			

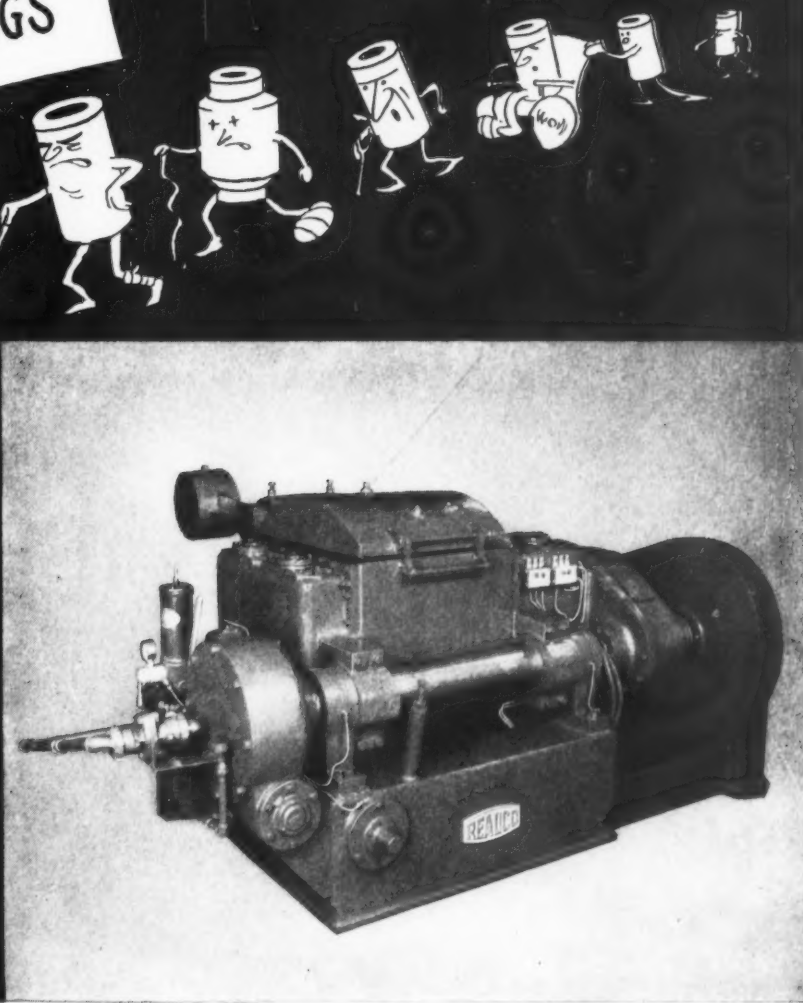
Prefix X denotes variations in the range of elements. Prefix T is used with the manganese steels (1300 Series) to avoid confusion with steels of somewhat different by the same number, but without the prefix.

*Annealed. **Spheroidized Annealed.

MACHINERY'S Data Sheet No. 424, August, 1940



QUICK NOURISHMENT FOR STARVED BEARINGS



Look at these bright, happy-faced bearings tripping down the page from the "Farval Central Station"—then remember this picture is just another way of repeating a message that industrial Executives can never hear too often:—

The Farval Centralized System of Lubrication *keeps bearings well nourished.* It delivers lubricant under high pressure, in exact measured quantities, as frequently as



desired and—not a bearing is missed.

It reduces labor of oiling; eliminates waste of lubricant; increases production; reduces repairs and maintenance and prolongs the life of equipment.

Farval is a *productive investment!* It quickly pays for itself—then continues earning for you at the same rapid rate.

The Farval Corporation, 3276 East 80th St., Cleveland, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Manufacturers of Automotive and Industrial Worm Gearing
In Canada: PEACOCK BROTHERS LIMITED



He's Saving



G-E combination starters for
controlling 7½-hp spray-pump
motors

General Electric, Section C 676-15
Schenectady, N. Y.

Please send me information on your combination starters that reduce installation costs and increase safety.

Name

Firm

Address

City

Motor Starter by

g His Boss Money and Increasing Plant Safety

THE electrician in the picture is almost ready to insert the fuses, close the cover, and throw in the circuit switch. Another motor will be ready for operation—hours sooner than if he had installed (1) a manual circuit switch, plus (2) a separate magnetic starter. He saved time because, when these are installed as separate items, they must be mounted, conduit must be run, and they must be interconnected—all of which adds to the cost of the complete installed control.

Next time he inspects the starter, he'll be protected against accidental contact with live parts, too, because *the cover can't be opened unless all exposed parts of the starter are dead*. And as long as the cover remains open, he's sure that power will remain OFF. While he's working on the starter he's sure that it cannot be energized by another person accidentally closing a switch.

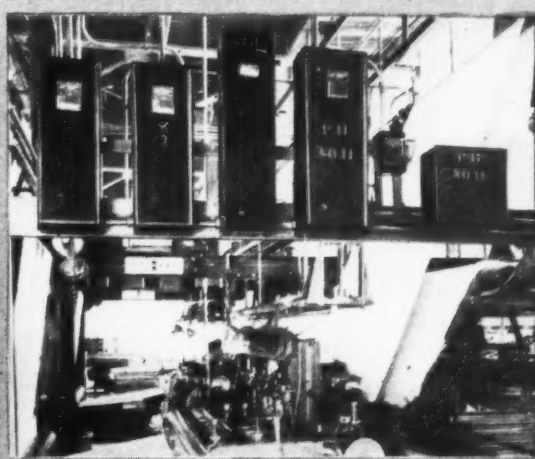
If you're not already using these money-saving and safety-boosting G-E combination starters in your plant, send for further information. Or better yet, call our local representative or dealer. General Electric, Schenectady, N. Y.



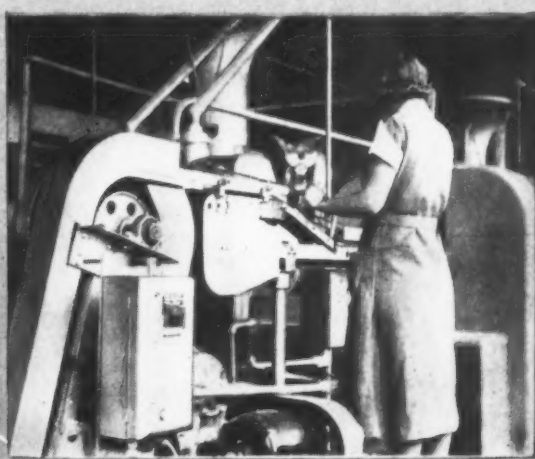
In the Plants of Three Enthusiastic Users



In a southern textile plant, these combination starters control spinning frames.



These starters control Garnett machines in a plant making automotive upholstery.



This starter controls the drive for a packaging conveyor in the plant of a dentifrice manufacturer.

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163

GENERAL  ELECTRIC

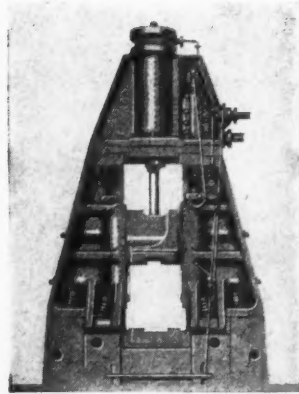
Drop Forgings

for
STRENGTH
and
SAFETY

Drop forgings are known to everyone as the ideal combination of strength and safety. MODERN drop forgings, made on Chambersburg Hammers, are accurate forgings, using less metal and requiring less machining. Through the precision and speed with which Chambersburg Hammers work, forgings of greater accuracy and lighter weight can be produced — and often at lower forging costs. But FINISHED cost is always lower because of less metal being needed, and less machining. The use of drop forgings in your product may increase your profits, too.

CHAMBERSBURG ENGINEERING CO., CHAMBERSBURG, PA.

CHAMBERSBURG



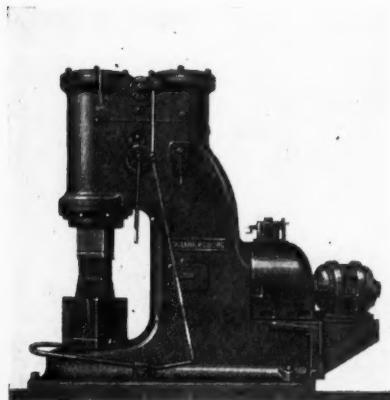
STEAM DROP HAMMERS

Standard of the industry. Greater production, greater steam or air economy, and greater accuracy. The Chambersburg patented Slide Valve is featured.



BOARD DROP HAMMERS

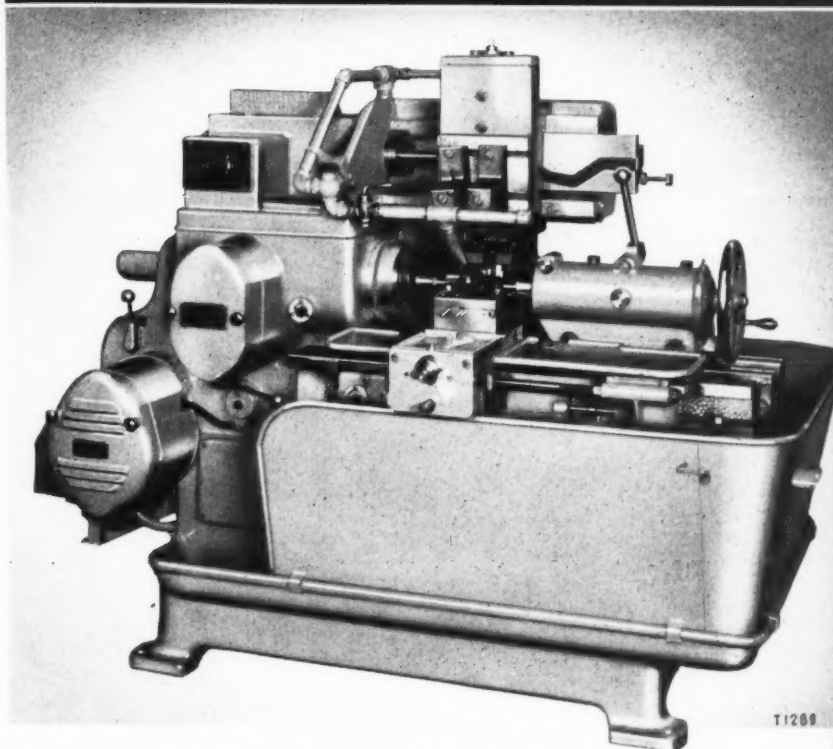
Frame-to-anvil construction, front rod design, simplicity of motor drive, and increased board life characterize this efficient Board Drop Hammer.



PNEUMATIC FORGING HAMMERS

Self-contained — motor, compressor, and hammer in one unit. Has high productive capacity. Its greater forging output is due to its heavier anvil construction, higher impact speeds and greater rapidity of blows.

Automatic Stub Lathe Gives More Work For Less Money

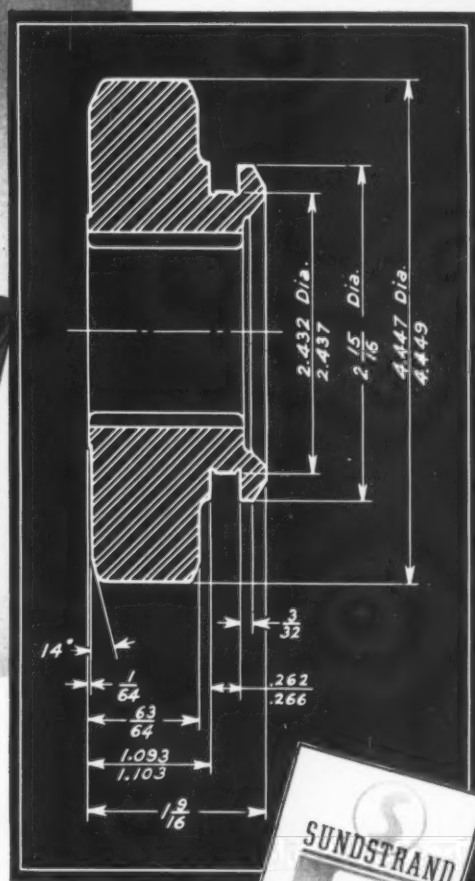


T1288

Saves Operations, Floor Space and Handling

Moving in from 3 directions, 11 tools rough- and finish-turn forged steel gear-blanks on the Sundstrand Automatic Stub Lathe shown above. Formerly, one operator processed these parts on two machines. Now, one Model 10 Stub Lathe with overhead slide and straight in-feed on front carriage does the same turning, adds a semi-finish operation in the groove; saves investment, floor space, tool cost, subsequent machining . . . and the operator can use half of his time for running other machines. Sundstrand Automatic Stub Lathes provide similar advantages on an enormous variety of other turning. What they have saved for others may also be saved for you. Investigate.

Sundstrand Machine Tool Co.
2530 Eleventh Street, Rockford, Illinois, U. S. A.



Do you know how easy it is to set up Sundstrand Automatic Stub Lathes? How fast they operate? What a wide variety of cycles they provide by simple adjustments? These, and other cost-cutting production increasing advantages, are described in the booklet shown above. Write for a free copy, today. Ask for Bulletin 391.



RIGIDMILS-STUB LATHES

Tool Grinders - Drilling & Centering Machines
Hydraulic Operating Equipment - Special Machinery

MADE IN ROCKFORD, ILLINOIS, U. S. A.

Machinery - AUGUST, 1954

WE ARE PREPARED!

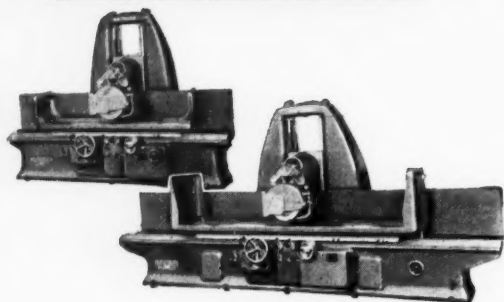
♦ ♦ TO OFFER FOR THE USE OF
OUR GOVERNMENT AND AMERICAN
INDUSTRY THE VERY FINEST AND
LATEST BROACHING MACHINE AND
TOOL EQUIPMENT AVAILABLE.

AMERICAN BROACH & MACHINE CO.

ANN ARBOR, MICHIGAN, U. S. A.



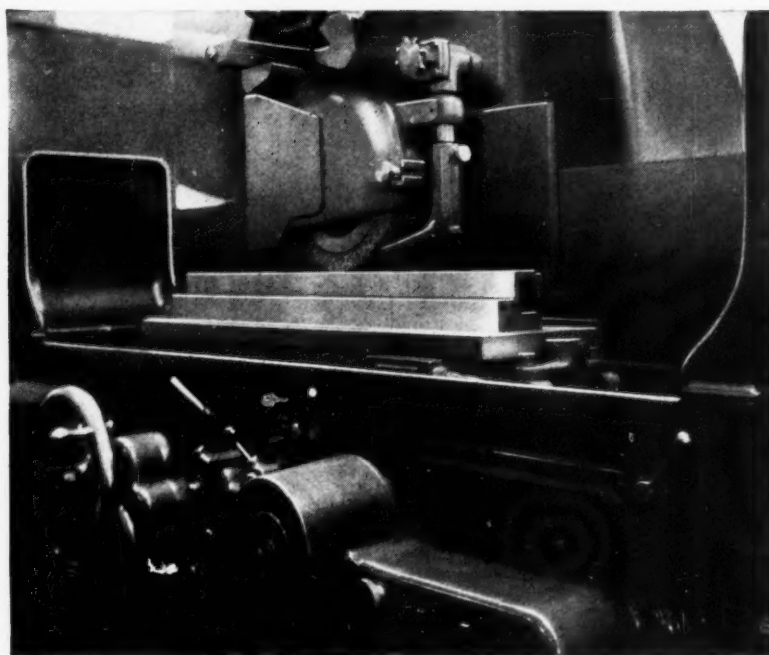
BROACHING MACHINES, PRESSES, BROACHING TOOLS, SPECIAL MACHINERY



MATTISON GRINDER

Cuts Time 60%

When added together, time savings like this not only make a big difference in manufacturing cost but help speed up delivery schedules. To show what Mattison Grinders can do on your work, send us blue prints for production estimates.



Machine: Mattison 12" x 48" Surface Grinder
Work: Hardened Steel Table Box
Stock Removal:015" each surface and shoulders
Remarks:—Parts ground complete eight surfaces, including flat and shoulder grinding. 60% time saving on Mattison Grinder over previous grinding method.

MATTISON MACHINE WORKS—ROCKFORD, ILLINOIS

MADE IN ROCKFORD, ILLINOIS, U. S. A.

Five "Caterpillar" Diesel Tractors operate bulldozers, Carryalls and a ripper in making this 86-ft. cut on California Highway 101 between Gaviota Pass and Buelleton. Location is very rocky, includes grades at 45°. Four D8's consume about five gallons of fuel an hour, each; one D7, three gallons.

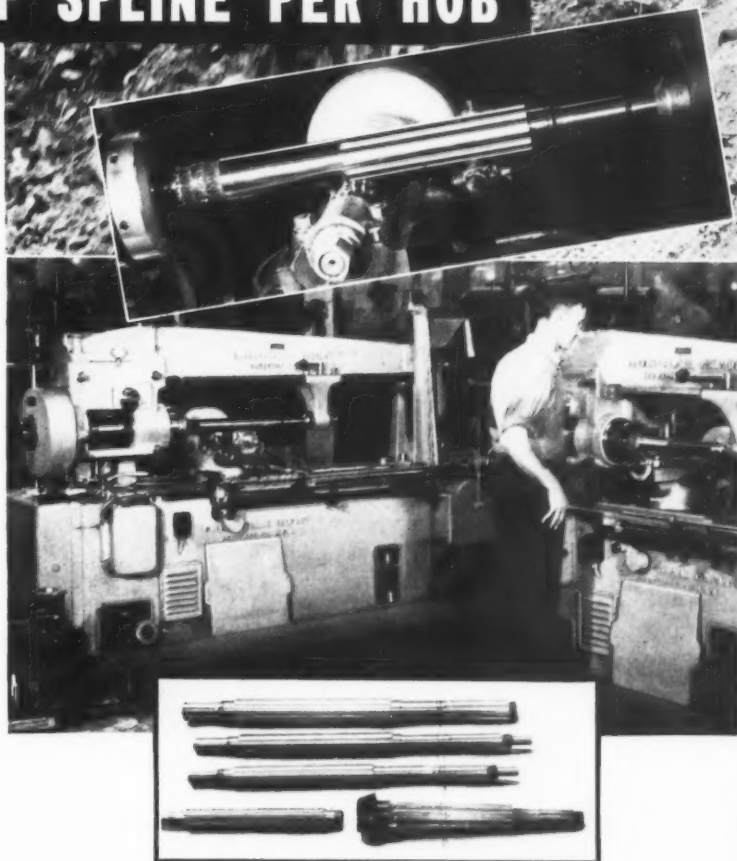
16,593 LINEAL INCHES OF SPLINE PER HOB

High accuracy and fine finish *Cost Less* with Barber-Colman Hobbing Service

If you want to improve your product or reduce your manufacturing costs, make use of Barber-Colman Hobbing Service.

Here, for example, at Caterpillar Tractor Co., two Barber-Colman Type A Hobbing Machines, equipped with Barber-Colman Hobs, are used to spline miscellaneous shafts. One machine is standard length, and the other has extra length for the long shafts. Approximately 12 transmission shafts having a spline $16\frac{9}{32}$ " long are hobbled in eight hours. High accuracy and fine finish are consistently held, and average hob life is 16,593 lineal inches of spline.

If you have shaft splining, or similar work, by all means ask your nearest Barber-Colman representative about it.



Quick Operation Details

Name of Part — Transmission Shaft.

Material — 1045 steel — heat treated — Brin. Hard. 3.6 — 3.8 M.M. Diameter.

Operation — Hobbing ten-key spline shaft; $16\frac{9}{32}$ " long; 0.356" — 0.355" key width; 2.315" Outside Diameter. Conventional cutting.

Hobbing Machine — Barber-Colman Type A Long Bed.

Hobs — Barber-Colman Ground Spline Hob; $2\frac{3}{4}$ " diameter and length; $1\frac{1}{4}$ " straight bore; 15 gashes; single thread; non-topping.

Holding — Between centers.

Feed — 0.062 per rev. of work.

Speed — Hob speed 66 r.p.m.

Production Time — 10 to 12 spline shafts in 8 hours.

Pieces per Setting — 2.

Pieces per Grind — 10.

Hob Life — 8 to 10 sharpenings.

Remarks — One operator runs both Barber-Colman Hobbing Machines on this miscellaneous work.



PRODUCTS

HOBBS, HOBGING
MACHINES, HOB
SHARPENING MA-
CHINES, REAMERS,
REAMER SHARP-
ENING MACHINES,
MILLING CUTTERS,
SPECIAL TOOLS

Write for bulletin No. 1099 describing Barber-Colman Type A Hobbing Machines used for hobbing spur and spiral gears, spline shafts, and other hobbled forms. Designed for general-purpose or production applications. Catalog K covers Barber-Colman Hobs, Milling Cutters, and Reamers.



Barber-Colman Company

General Offices and Plant 203 Loomis St., Rockford, Illinois, U. S. A.

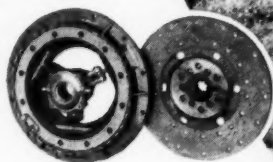
MADE IN ROCKFORD, ILLINOIS, U. S. A.

Rockford Clutches

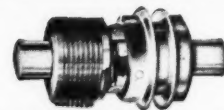
A Sweeping Success in Austin-Western Sweepers

A Rockford Spring-Loaded Clutch controls the transmission of power in the Austin-Western Sweeper illustrated, being a sweeping success in its share of making operation smooth, easy and dependable. Rockford Industrial Clutches, in Spring-Loaded or Over-Center types, provide highly satisfactory clutch control for other kinds of road equipment, for industrial trucks, cranes, tractors, marine engines, Diesel engines, farm machinery, locomotives, power units, and other applications. The Spring-Loaded Clutch operates like an automobile clutch; the Over-Center locks in or out of engagement. Reliable, durable; Rockford Industrial Clutches are notably successful and economical. Free engineering service available for developing new applications of Rockford Clutches. Write today for full information.

Rockford Industrial Clutches are made with single and double drive plates, for operation in oil or dry, in sizes up to 20" diameter for transmitting 2 to 80 h.p. at 100 r.p.m. Investigate.



Rockford Over-Center Clutch



Pullmore Multiple - Disc Clutch
Single and Double. Operate in oil or dry. Capacities from 1 h.p. to 75 h.p. at 500 r.p.m.

Rockford Drilling Machine Division *Borg-Warner Corporation*
310 Catherine Street, Rockford, Illinois, U. S. A.

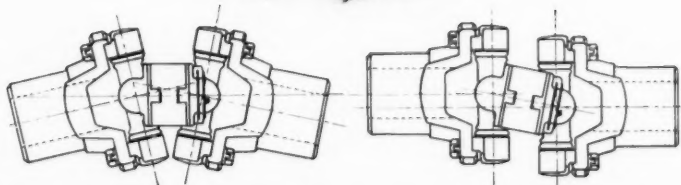
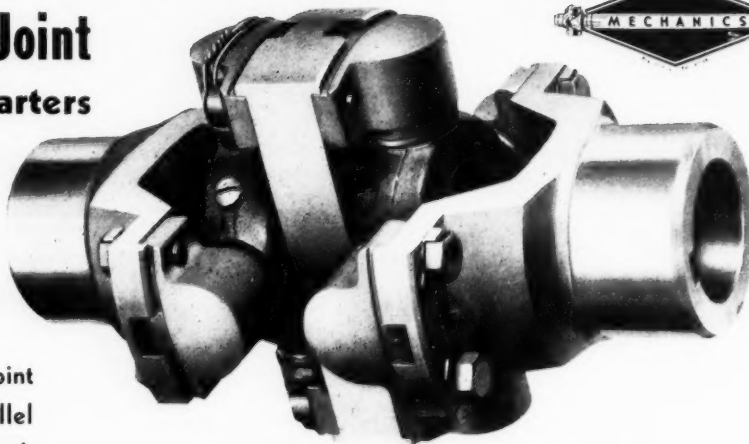
Over-Center Clutches • Spring-Loaded Clutches • Pullmore Clutches

Mechanics *Roller Bearing* UNIVERSAL JOINTS

Type C Double Universal Joint For High Efficiency in Close Quarters

In close quarters, where there is not enough space for the conventional installation of two universal joints and a connecting shaft, the Mechanics Type C Roller Bearing Double Universal Joint solves the problem.

In one compact unit, the Type C Double Joint compensates for either angular or offset-parallel conditions; transmitting rotation uniformly with high efficiency. It has typical Mechanics Roller Bearing construction; is rugged, inherently balanced; is available in seven sizes with end fittings to connect a wide variety of spline, taper and straight shafts. Investigate. Write, today.



Type C Mechanics Roller Bearing Universal Joint operates at angles up to 12°, indicated above at left; and on parallel offset centers up to 1/2" as shown at right.

Mechanics Universal Joint Division

BORG-WARNER CORPORATION

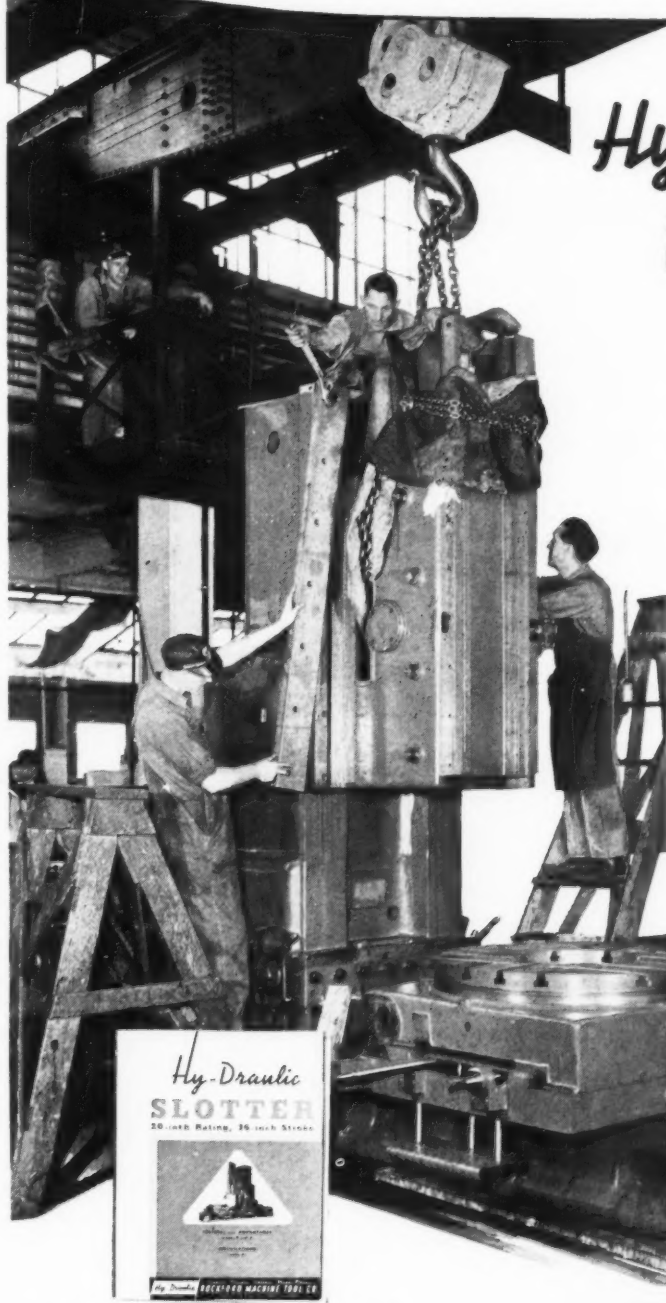
2024 Harrison Ave.

Rockford, Illinois

MADE IN ROCKFORD, ILLINOIS, U. S. A.

Machinery—August, 1940

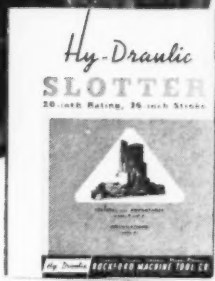
Building *Hy-Draulic* Machine Tools ... As Fast As It Can Be Done Right



Hy-Draulic Slotter Steps 'Way Ahead

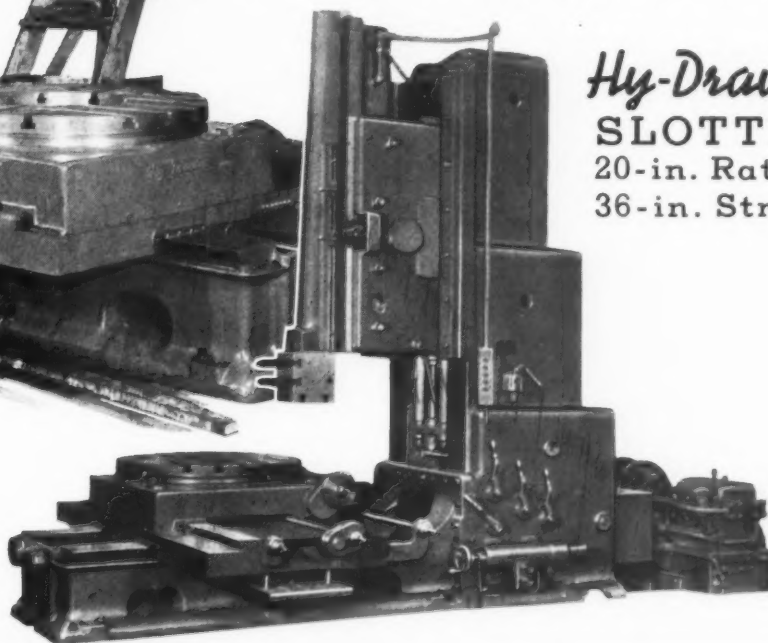
Crack mechanics, especially skilled in assembling machine tools; men shown here are building outstanding features and advantages into *Hy-Draulic* Slotters fast . . . as fast as it can be done right. Hydraulic ram drive, hydraulic feeds; new convenience of operation and control; with other exclusive features, put the *Hy-Draulic* Slotter 'way out in front for quick set-up, high productive capacity, accuracy, and fine finish of product. A big, powerful machine; the *Hy-Draulic* Slotter is faster and easier to handle than any other slotter you've ever seen. Let us refer you to the nearest installation, or come to Rockford and take a look. Meanwhile "read all about it" in Bulletin 383. Write for your copy today.

Hy-Draulic
SLOTTER
20-in. Rating
36-in. Stroke



Write for Bulletin 383

Bulletin shown above points out exclusive features, describes *Hy-Draulic* advantages, shows specifications and details. Write for your copy today. Ask for Bulletin 383.

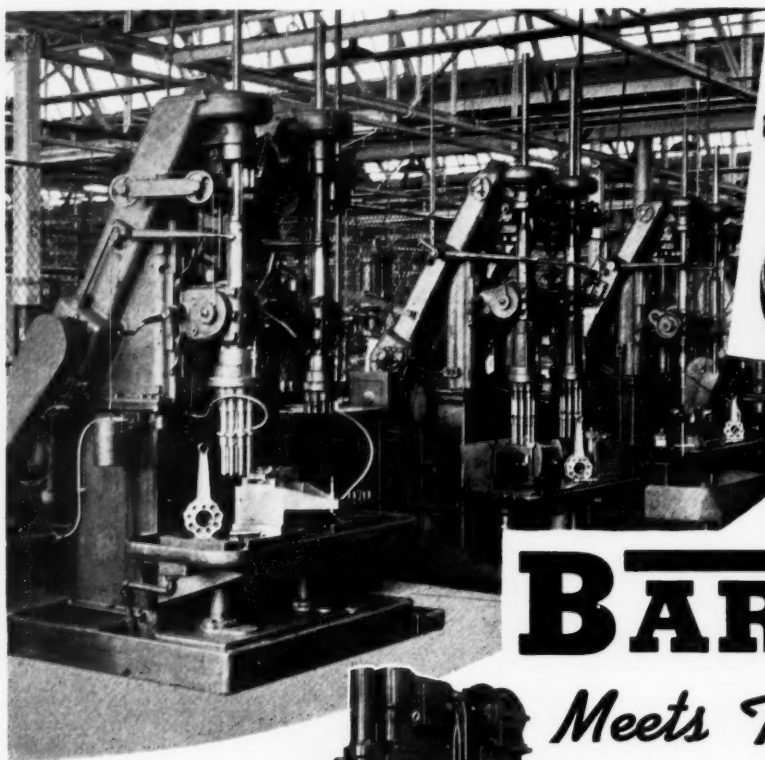


Reg. U. S. Pat. Off.

Shapers.. Planers.. Slotters.. Shaper-Planers
ROCKFORD MACHINE TOOL CO.
ROCKFORD, ILLINOIS, U. S. A.

MADE IN ROCKFORD, ILLINOIS, U. S. A.

Machinery—August, 1939



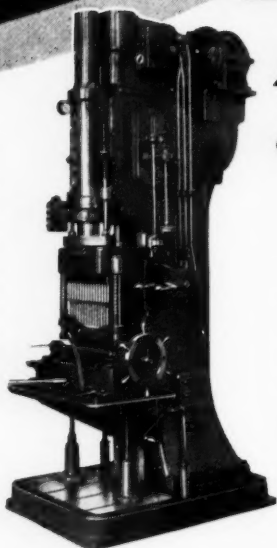
How

BARNESDRIL

*Meets Today's Requirements
For Drilling and Honing*

DRILLING

Above, at right, close-up shows one of our smaller High Production Units for rough-finish and fine-boring wrist pin holes in aluminum alloy pistons. Directly above, view in airplane motor plant which has more than 100 BARNESDRIL spindles in operation. At right, Hydram Drilling Machine on ordnance work, one of many different applications. Write for details.

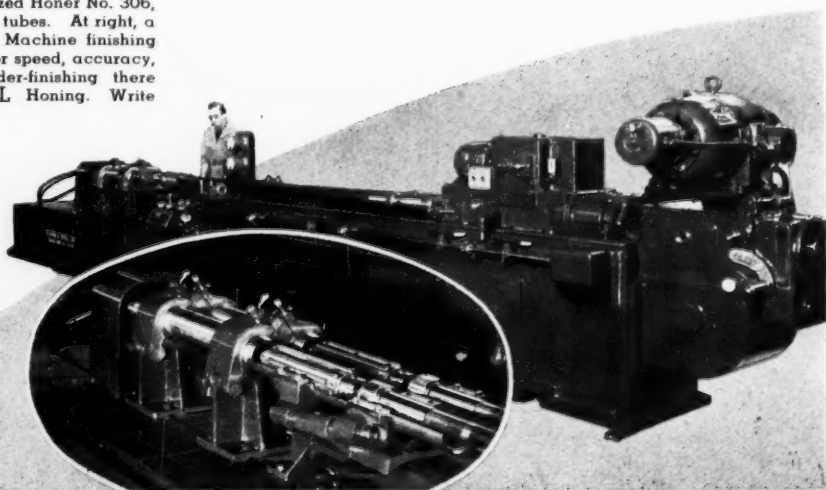
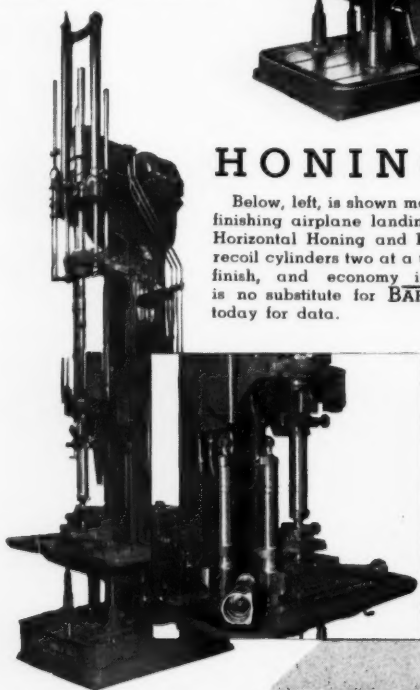


BARNESDRIL Machines for drilling, boring, tapping and similar operations; ranging generally from $\frac{1}{2}$ " to 4" diameter; have power and speed to drive modern cutting tools to capacity; strength and rigidity to maintain their high accuracy in sustained heavy duty; durability and reasonable prices to provide maximum economy. Made in a variety of sizes and types from simple single-purpose to those having 8 quick-change speeds and feeds; in Gangs, High Production Units and heavy duty Hydram Drillers.

BARNESDRIL Honers are built in Vertical, Angular, and Horizontal types; in a complete range of sizes for finishing any hole, bore, or internal cylinder for which a hone can be made; and for certain external honing and lapping operations. Investigate. Write today for our Catalog M.

HONING

Below, left, is shown medium sized Honer No. 306, finishing airplane landing gear tubes. At right, a Horizontal Honing and Lapping Machine finishing recoil cylinders two at a time. For speed, accuracy, finish, and economy in cylinder-finishing there is no substitute for BARNESDRIL Honing. Write today for data.



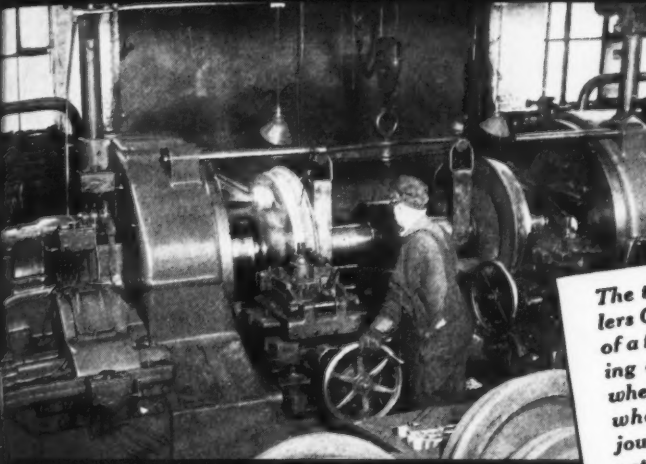
Barnes Drill Co.

814 CHESTNUT STREET
ROCKFORD
ILLINOIS, U. S. A.

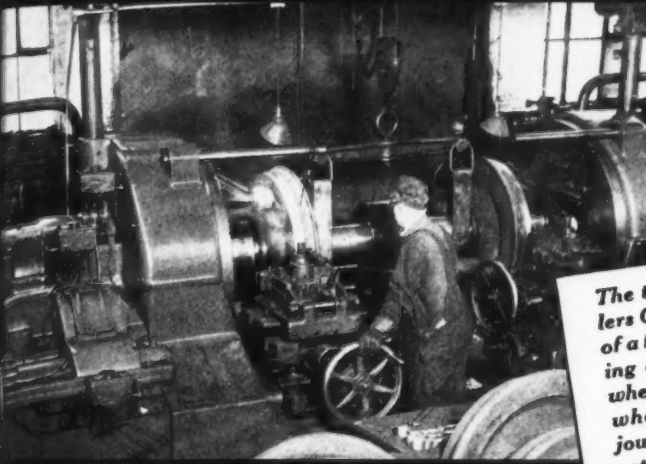
MADE IN ROCKFORD, ILLINOIS, U. S. A.



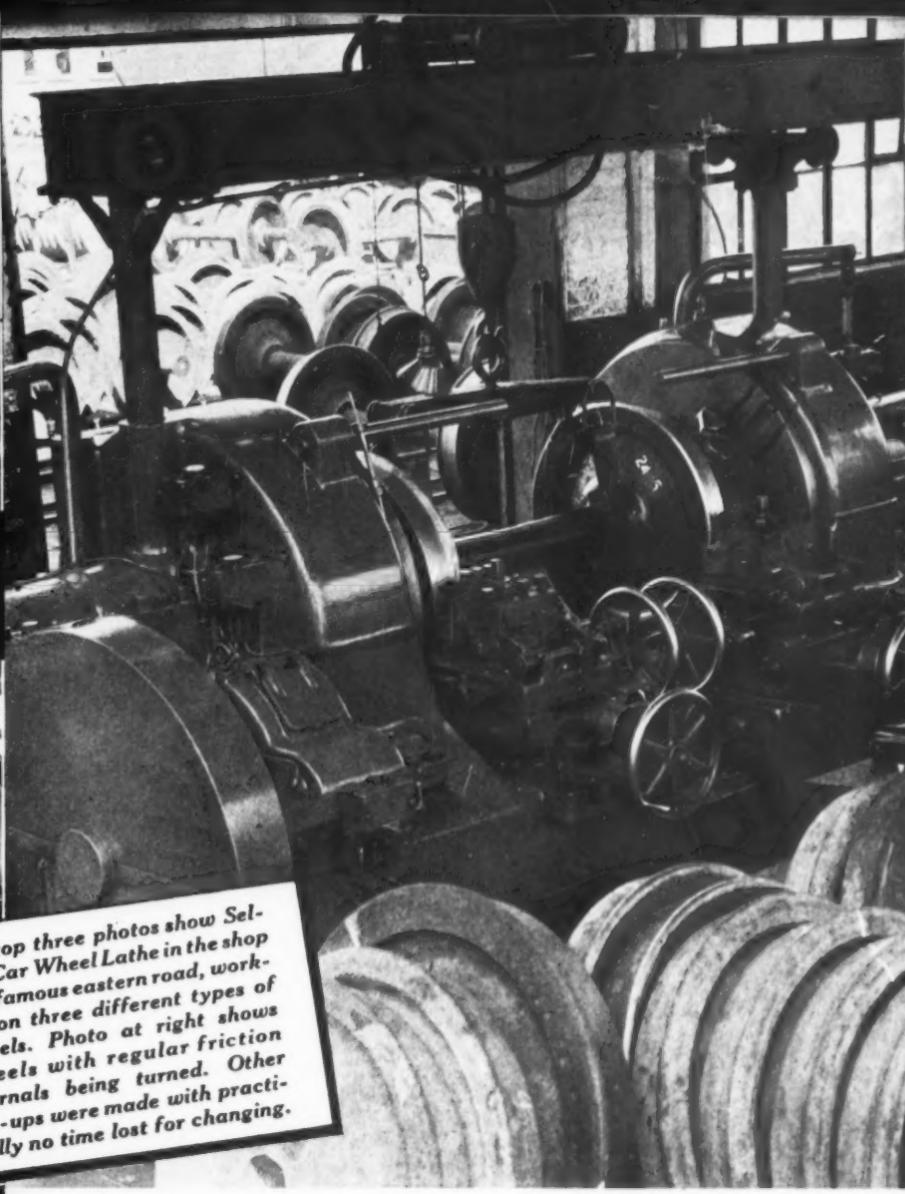
TRAILER WHEELS WITH FRICTION JOURNALS
BEING TURNED ON SELLERS CAR WHEEL LATHE



The top three photos show Sellers Car Wheel Lathe in the shop of a famous eastern road, working on three different types of wheels. Photo at right shows wheels with regular friction journals being turned. Other set-ups were made with practically no time lost for changing.



ETHLEHEM BOOSTER WHEELS WITH ANTI-FRICTION BEARINGS AND CRANK PINS IN PLACE BEING TURNED ON SAME LATHE AS ABOVE

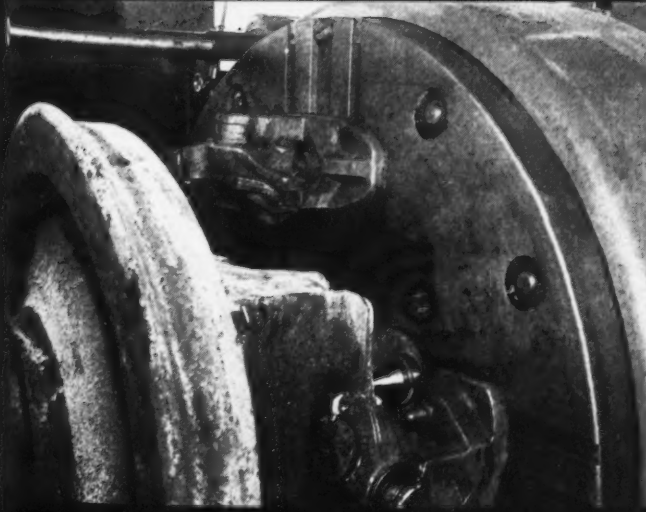


**ALL TYPES OF WHEELS ON THE
SAME LATHE—with the same
ROUND, SMOOTH, ACCURATE FINISH**

EXAMPLES of the great versatility of the Sellers Car Wheel Lathe, the lathe with the famous "Smooth Finish" turrets, are shown in these photographs. What is more important, however, is the uniform round, smooth, accurate finish (so necessary in these days of high speed trains) that results wherever these lathes are installed.

WILLIAM SELLERS & CO., INCORPORATED
1612 Hamilton Street,
Philadelphia, Pa.

FOUNDED
SELLERS
1848



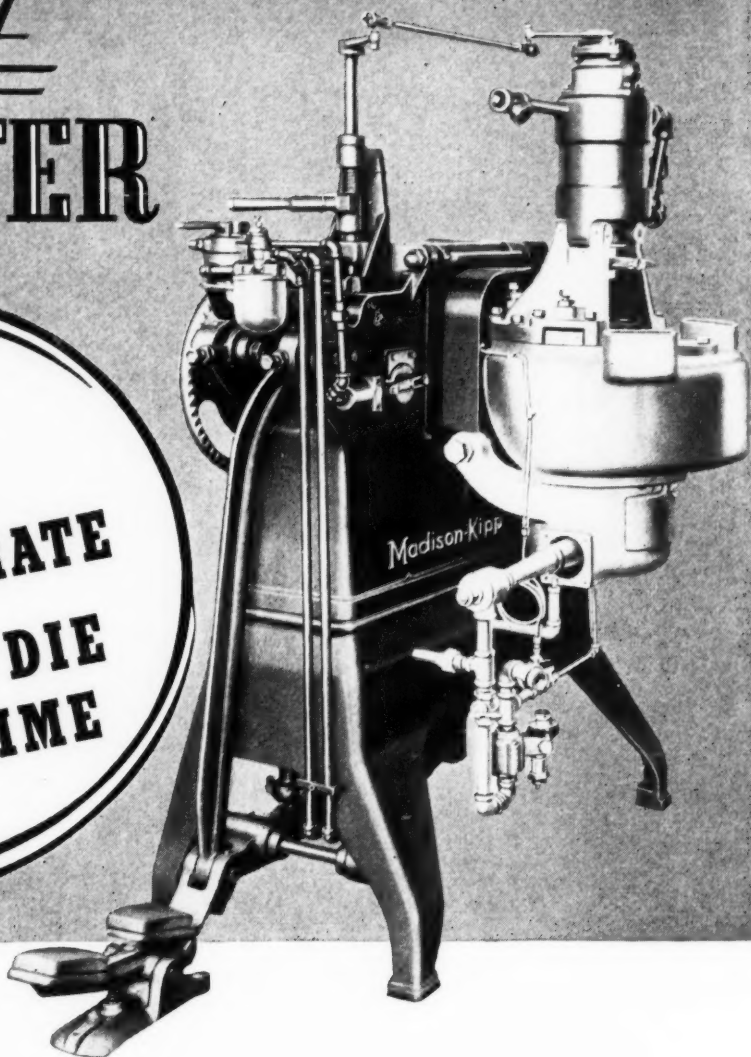
ABOVE IS SHOWN ANTI-FRICTION MOUNTED WHEEL BEING TURNED ON SAME MODEL LATHE (ON WESTERN ROAD) AS SHOWN ABOVE

Sellers

THE MOST POPULAR DIE CASTING MACHINE BUILT TODAY

The Fast **KIPPCASTER**

- ★ INEXPENSIVE
- ★ EASY TO OPERATE
- ★ TEN MINUTE DIE CHANGING TIME



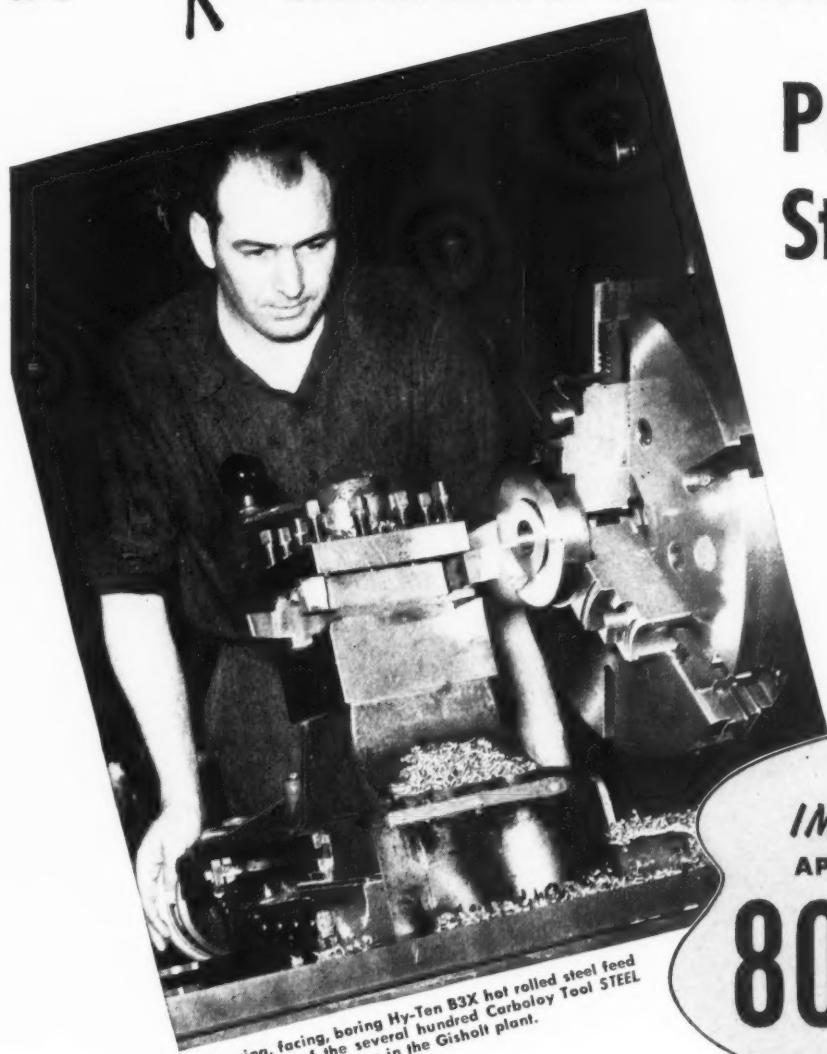
*T*he fast Kippcaster is designed for the production of small parts in Zinc, Lead, and Tin alloys. There are other Madison-Kipp Machines for die casting nearly all sizes of castings in any die casting alloy. Send samples and blue prints to Madison for a complete analysis.



Sole Agent in England: Wm. Coulthard & Co., Ltd., Carlisle

MADISON-KIPP CORPORATION, 203 Waubesa St., Madison, Wis., U. S. A.

BY *Simply* [^] CHANGING TO CARBOLOY TOOLS...



Turning, facing, boring Hy-Ten B3X hot rolled steel feed gear—one of the several hundred Carboloy Tool STEEL CUTTING applications in the Gisholt plant.

Production **30%**
Stepped Up

ON MORE THAN 1000
MACHINING JOBS AT

GISHOLT!

IMPORTANT—CARBOLOY TOOL
APPLICATIONS AT GISHOLT ARE

**80% STEEL
CUTTING**

Sharing in common with other leading machine tool builders the abrupt increase in demand that has caused the operating rate of that industry to soar from 52.5% in January 1939 to 92.5% in May 1940, Gisholt Machine Company early sought to more extensively employ cemented carbide tools as one means of increasing machining production.

To meet the problem of applying carbide tools economically on the small-lot, diversified work typical of the machine tool industry (as compared to continuous production applications), Gisholt adopted the following procedure:

1. A carbide "application man" was appointed within

the plant to control all use and maintenance of carbide tools.

2. Ten basic styles of carbide tools were designed for general purpose use on 80% of the work in the shop.
3. Two grades of Carboloy—one for steel, one for all other metals—were selected for universal use.
4. A uniform method of carbide tool application was set up and adequate grinding facilities provided.

Result to date has been a 30% average increase in production on more than 1000 jobs to which Carboloy tools have been applied.

A 12-page booklet gives complete details. Write for your copy.

AGAIN—the general purpose use of Carboloy tools on small-lot, diversified work...
PAYS DIVIDENDS!

CARBOLOY COMPANY, INC., DETROIT, MICHIGAN • Chicago • Cleveland • Newark • Pittsburgh • Philadelphia • Worcester, Mass.

CARBOLOY

TUNGSTEN CARBIDE—TANTALUM CARBIDE—TITANIUM CARBIDE



FOR CUTTING, DRAWING, SHAPING, EXTRUDING METALS AND NON-METALLICS ★ FOR REDUCING WEAR ON EQUIPMENT OR PRODUCTS YOU USE OR MAKE



1940

Built to conform to MODERN Engineering standards of design and construction, this Cleveland One Point Press embodies many improvements for operating efficiency. It exerts a pressure of 200 tons, operates at the rate of 30 strokes per minute and is equipped with an electrically controlled hydraulically operated friction clutch and brake.

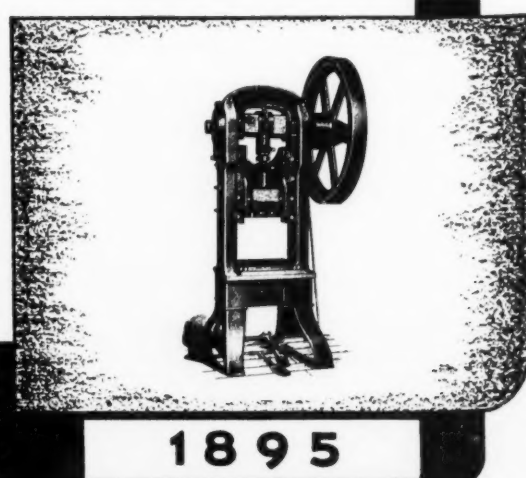
FORTY FIVE YEARS OF PRESS PROGRESS

The small illustration, which is reproduced from a Catalog of 1895, shows a Cleveland Single Crank Press which was built over 45 years ago while the large engraving illustrates a MODERN Cleveland Single Point Press designed to meet the needs of today for speed, accuracy and economy of operation in the production of pressed metal parts.

This Single Point Press is symmetrical front and back and the gearing, which runs in a bath of oil, is located in the box type crown together with the drive unit and both can readily be removed whenever necessary.

These Modern Single Point Presses can be furnished in sizes and capacities to meet particular requirements—write for further details.

THE CLEVELAND PUNCH & SHEAR WORKS COMPANY
CLEVELAND, OHIO
NEW YORK · CHICAGO · DETROIT · PHILADELPHIA



LET

Oliver

No. 2 ARC FACE MILL GRINDER

For all face mills from 6 to 26 inches in diameter. Eliminates sharp corners, producing edges perfectly ground to any radius. Oliver-conditioned Face Mills give smoother operation and cut longer between grinds. Used by leading manufacturers in the automotive and other high production industries.



EQUIP YOUR TOOLROOM for BETTER PRODUCTION

Better production begins in an Oliver-equipped toolroom! A few simple Oliver Tool Conditioners will put your tool regrinding on a high efficiency-basis, doing away with slow, costly hand-controlled methods. The Oliver method reproduces the correct contour of drills, taps, cutting tools, keeping them cutting at "right out of the box" efficiency as long as they last.

For improved production, start in the toolroom! Let us show you how Oliver Tool Conditioners can **reduce tool breakage, work spoilage and production delays** and keep your production at a high level of efficiency —day in, day out.

OLIVER INSTRUMENT COMPANY
1410 EAST MAUMEE ST. ADRIAN, MICH.

No. 510 DRILLPOINTER

Automatic operation produces the patented Oliver point with variable clearances. Holds drills from 1/4" to 3" in diameter and produces any point angle from 82 to 160 degrees. Ball bearing mounted main shafts and Timken equipped spindle assure smooth, accurate operation. In one case, the Oliver Drillpointer increased drill service from 175 to 500 holes per grind! Write for interesting new catalog.



**Don't Neglect
Your Toolroom
It's the Backbone
of Production!**

PREPAREDNESS FOR NATIONAL DEFENSE



★

FOR the swift mobilization of America's mass production resources, in the service of national defense, Bower was fully prepared.

Always geared up for high capacity production, Bower's facilities were immediately available to manufacturers of defense equipment.

And the Bower product, already approved in every leading industrial field, could be used at once for implements of defense.

All manufacturers of bearing-equipped machinery are invited to submit their bearing requirements to Bower engineers.

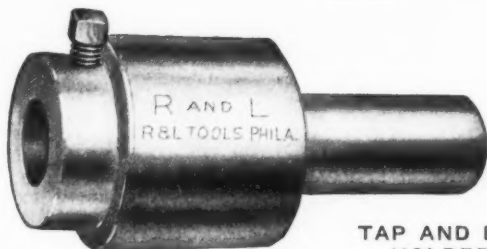
BOWER
ROLLER BEARING CO.
Detroit Michigan





R & L TURNING TOOL

Shown set up for drilling, turning and burnishing. The Tantalum Carbide backrest may be removed and the new Roller Backrest, shown below, substituted.



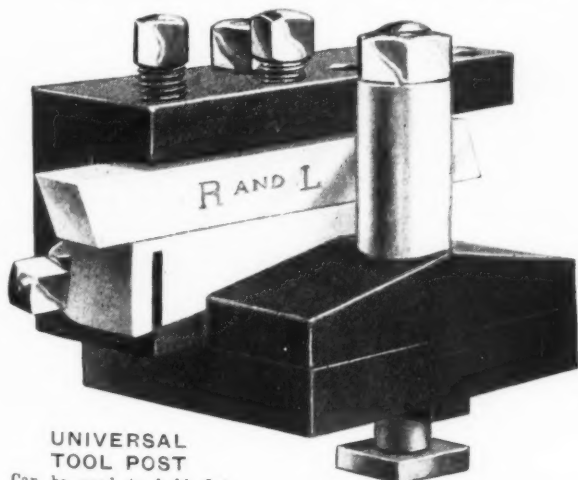
TAP AND DIE HOLDER

New design eliminates spring plungers and small screws. Engaging teeth separate fully — and instantly — when released, eliminating wear.



ROLLER BACKREST

Made in five sizes to fit the five sizes of R & L Turning Tools. Easily set up for either right or left hand turning.



UNIVERSAL TOOL POST

Can be used to hold flat or square tools on front or back cross slide with the spindle running either direction.

Simplify and Save with **R AND L** TOOLS

R & L multiple operation features enable you to simplify and combine operations, to save by using fewer tools. R & L right and left hand features mean fewer tool changes and greater savings in time.

R & L simplicity of design means savings in upkeep and considerable savings in first cost. For instance, R & L Turning Tool saves you over \$200 in first cost by replacing fourteen separate, single purpose tools. It can be used for turning several diameters at once, for drilling and turning, for pointing, centering and burnishing.

Fill out the coupon below for the full story of how R & L *simplicity* means greater *savings* on a wide variety of turning and threading jobs.

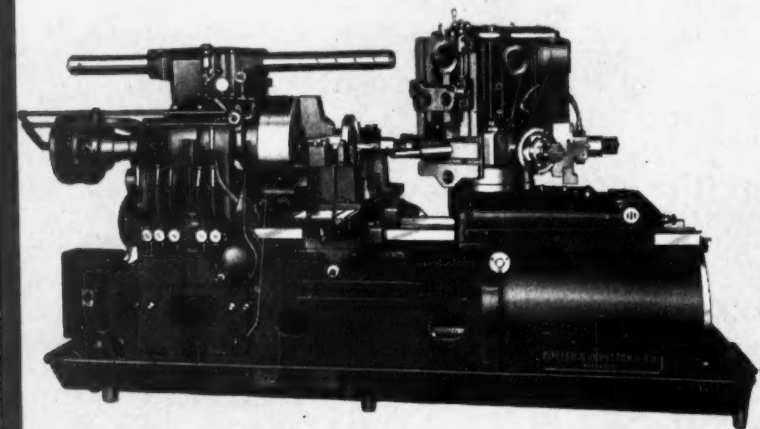
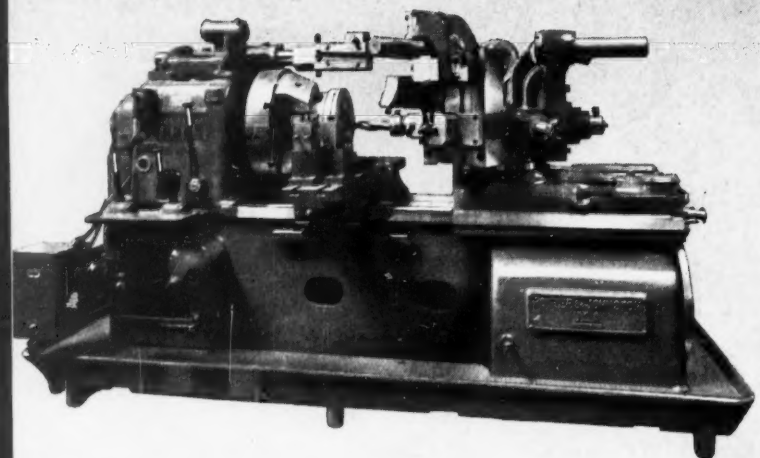
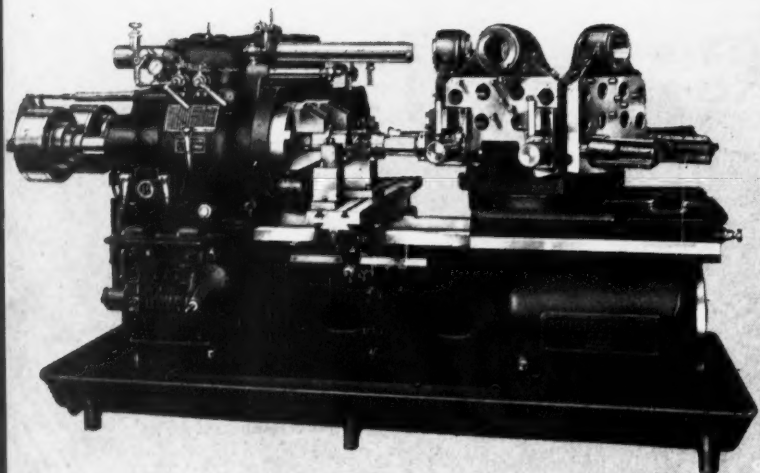
R AND L TOOLS

1825 Bristol St., Nicetown, Philadelphia, Pa.

Please send me complete information on the R & L Tools described above.

NAME.....
COMPANY.....
STREET.....
CITY.....STATE.....

Leaders of the Line » »



Automatic CHUCKING MACHINES

These popular models of two-spindle machines have been added to the regular 5D Power Flex line to cover the void hitherto existing in Automatic Chucking Machines. For a wide range of work, requiring infrequent changeovers, these three 2-spindle models and their unique construction provide the means for an increase in output per square foot of floor space... a conservation of power... a moderate initial investment.

These four models of the P & J line have undergone consistent improvements; their performance in today's production have firmly established them as the leading Automatic Chucking Machines of the single spindle type. Four automatic changes of speed—three selective automatic changes of feed, varying with the spindle speeds—and the ability to make all automatic changes while under cut—these features distinguish these leaders as P & J's contributions to lower production costs.

For work beyond the range of the 5DEL, these two models are outstanding units in their class. These machines have the power and rigidity required for cutting alloy steel forgings at maximum cutting speeds. Their peculiar adaptability to the requirements of aircraft engine and propeller manufacture has resulted in a world-wide acceptance of these machines. Divided labor costs—less operator fatigue—extreme accuracy—increased profits—these are characteristics of all P & J Automatic Chucking Machines!

Write for new catalogs giving full details on the construction and operation of these tools

POTTER & JOHNSTON MACHINE CO., Pawtucket, R. I., U. S. A.

FACTORY REPRESENTATIVES: William L. Martin, Headquarters at Factory: New England States and Eastern New York and New Jersey; A. W. Stone, 986 Kenyon Ave., Plainfield, N. J.; Western New York and New Jersey, Eastern Pennsylvania, Maryland and Delaware; G. Tell DuBois, 8-164 General Motors Building, Detroit, Michigan; Michigan and the City of Toledo, Ohio; Louis K. Voelk, 3865 Woodbridge Road, Cleveland, Ohio; Ohio—with the exception of Toledo, and Western Pennsylvania; Harry I. Schuster, 743 N. Fourth St., Milwaukee, Wisconsin; Illinois, Missouri, Wisconsin, Iowa and Indiana. AGENCIES: Star Machinery Company, 1741 First St., South, Seattle, Washington; Heneke-Morgan Machinery Co., 2026 Santa Fe Ave., Los Angeles, Calif.; Jenison Machinery Co., 20th and Tennessee Sts., San Francisco; Wassendorff, Nelms & Co., Inc., 320 Franklin Ave., Houston, Texas; Arthur Jackson Machine Tool Co., 60 Front St., West, Toronto 2, Ontario; Arthur Jackson Machine Tool Co., 437 Grosvenor Ave., Montreal, Canada; Burton Griffiths & Co., Ltd., Birmingham, England; R. S. Stokvis et Fils, Paris, France; Rotterdam, Holland and Brussels, Belgium; Maskinaktiebolaget Karlebo, Stockholm 1, Sweden; Ing. Erco's Vaghi, Milano, Italy; Yamatake & Co., Ltd., Tokyo, Japan (Imperial Export Co., 44 Whitehall St., New York, N. Y.); Almacoa, Zurich, Switzerland.



"UNBRAKO" MAKES THE DIFFERENCE

... THE DIFFERENCE BETWEEN UNCERTAIN SCREW PERFORMANCE AND UNQUESTIONABLE ASSURANCE OF UNFAILING STRENGTH AND UNIFORM ACCURACY



Pats. Pend.

KNURLED



SOCKET HEAD CAP SCREWS

Certain exclusive design features distinguish "Unbrako" Screw Products . . . features which qualify "Unbrakos" for service where no ordinary screw suffices. On "Unbrako" cap screws, it's the knurled "Better-Grip" heads that make the difference. For the knurling provides a non-slip surface for mechanic's fingers or pliers and permits making adjustments in many places where it is impossible to get a wrench—hence speeds up production.

Added to these outstanding advantages are the use of last-minute alloys, controlled heat treating, cold-forging, precision machining to micrometric specifications, thorough inspection of the finished product—basic factors that insure the strength and uniformity of each "Unbrako" Screw. Full details are worth your immediate investigation—write today!



Patented

SELF-LOCKING



HOLLOW SET SCREWS with the knurled points

Once set up with no more than average effort, "Unbrako" Self-Lockers just grab hold and grip . . . they STAY SET despite constant and severe vibration! Yet the knurled points which automatically lock the screws into place offer no extra resistance when setting up, adjusting or removing, and "Unbrakos" can be used any number of times with equal effectiveness.

On your equipment, "Unbrako" Self-Lockers will eliminate the cost of frequent maintenance check-ups and prevent the accidents and breakdowns caused when ordinary set screws fail to hold. A note on your letterhead brings full information—no obligation at all.

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA. BOX 22

— BRANCHES —

BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO

ARMSTRONG

... for
clean cut
knurling
use an

ARMSTRONG KNURLING TOOL

... with ...
ARMSTRONG HOB-CUT KNURLS

Knurling can be no better than the knurls and the tool that holds them, for it is a duplicating forming operation. That is why ARMSTRONG Knurls are individually hob-cut (to obtain perfectly formed teeth in every knurl). These high-carbon tool steel knurls are held within close limits in thickness and for diameter and concentricity.

Uniformity of pressure and hence of pattern, is further assured by the ARMSTRONG Knurling Tool, for it is self-centering. Knurl head swivels in a large knuckle or joint which keeps pressure on top and bottom knurls uniform. This permanent, ARMSTRONG TOOL HOLDER will resist the severest end and side thrust. Changes of knurls (as from "diamond" to "straight", or from "coarse" or "fine") are easily made by knocking out 2 hardened pins.



For sharp, clear knurling, use only ARMSTRONG Knurling Tools and ARMSTRONG Hob-Cut Knurls.

Write for Complete Catalog



ARMSTRONG BROS. TOOL CO.

"The Tool Holder People"

313 N. FRANCISCO AVE.

CHICAGO, U. S. A.

Eastern Warehouse and Sales:
199 Lafayette St., New York



ARMSTRONG TOOL HOLDERS Are Used in Over 96% of the Machine Shops and Tool Rooms

MONARCH'S
8-POINT
PLATFORM
for
Forward Looking
AMERICA



POINT 2 OF MONARCH'S PLATFORM

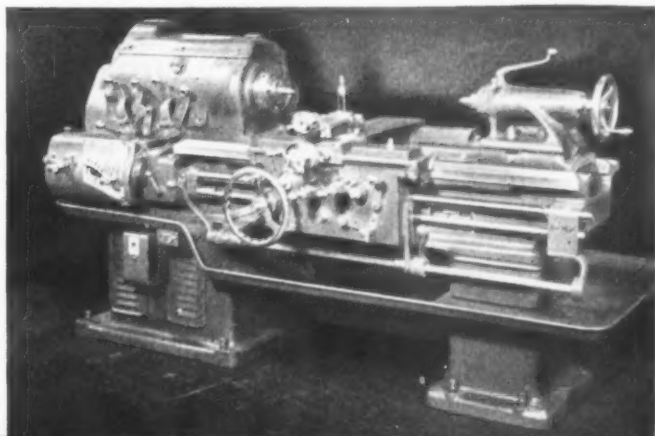
* * * INDUSTRY SHOULD TRAIN YOUNG MEN

NO employment without experience . . . no experience without employment. That has been the sad state of American youth in many fields since the Great Depression. Whirling in a vicious circle . . . thrown bewildered into a struggle for security—easy prey for any "ism" that comes along.

Industry owes an obligation to itself and to society, to assume its share of the responsibility for guiding these young Americans along the way to a more useful life. Training must be provided in order that skilled hands can be developed for tomorrow's production requirements . . . so that a second generation of leaders will be ready to assume responsibility when the time comes.

Monarch provides for the development of its skilled workers by conducting specialized, voluntary training groups—which, over a period of time, mold another generation of master craftsmen. The Monarch Machine Tool Company, Sidney, Ohio.

Monarch's New 14' x 30" "AA" Lathe



MONARCH LATHES

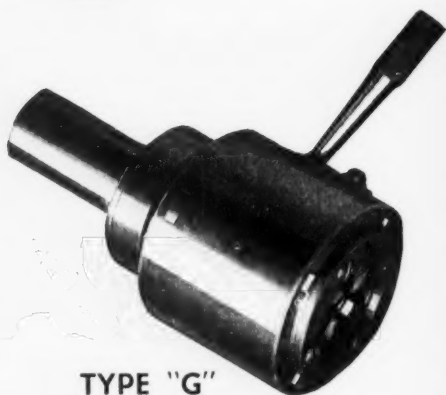
Murchey

THE Complete LINE

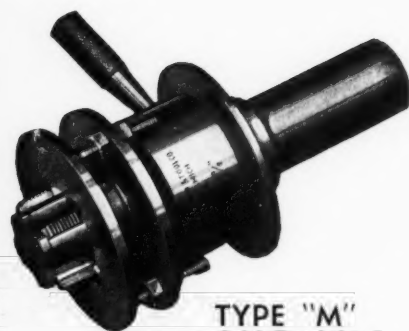
Murchey builds taps and die heads to cover every production threading need. Rugged, yet extremely compact and easily adjustable, they will produce clean-cut, accurate threads throughout their entire range of sizes and types. For greater accuracy and longer chaser life—for every quality that means **BETTER** thread production—let the Murchey line be your standard.

MURCHEY
MACHINE & TOOL CO.

951 PORTER STREET,
DETROIT, MICH.



TYPE "G"
SELF-OPENING
DIE HEAD



TYPE "M"
COLLAPSIBLE
TAP

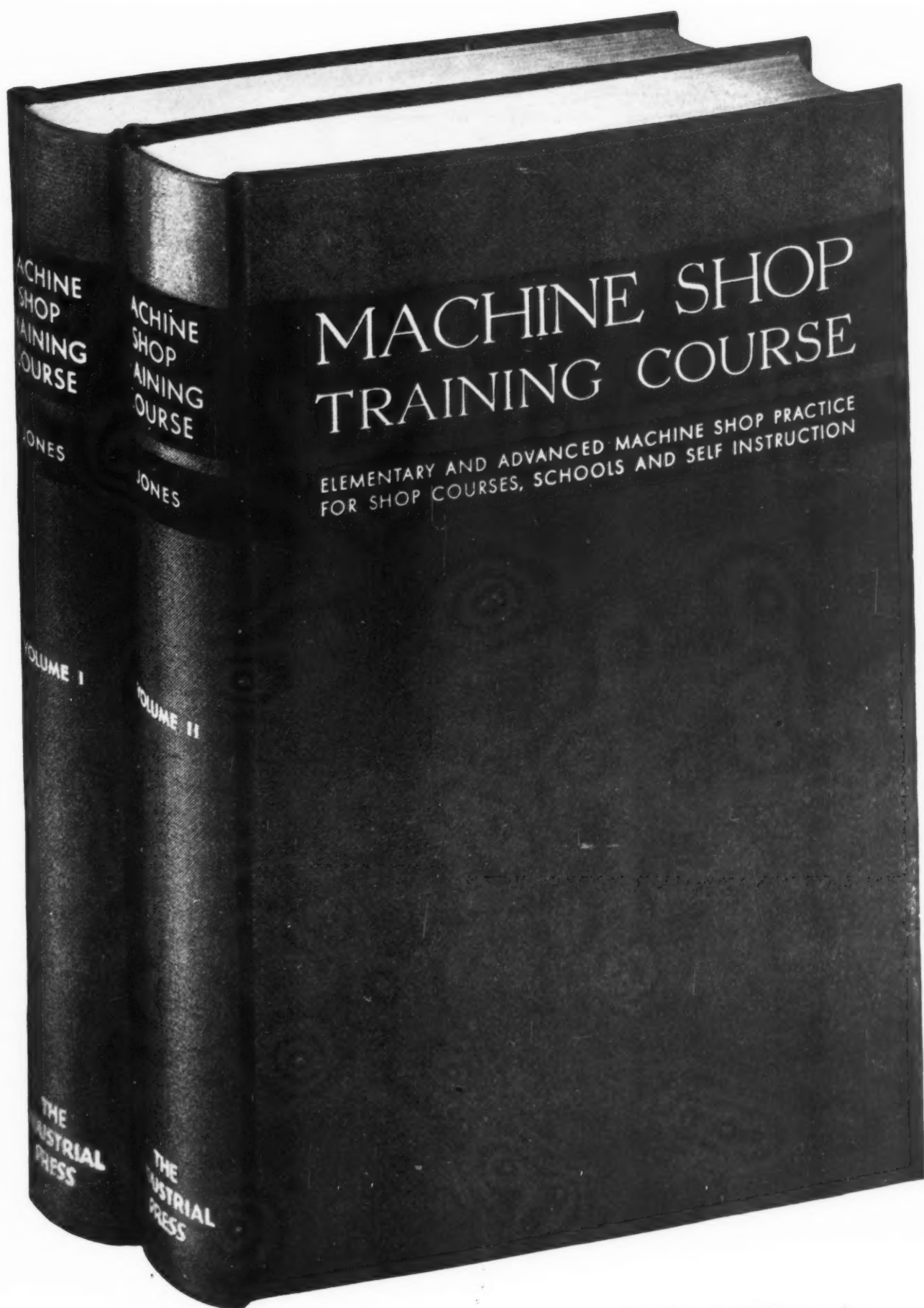


TYPE "CO"
SELF-OPENING
DIE HEAD

Murchey also manufactures a complete line of Bolt and Pipe Threading as well as Pipe Cutting-off Machines.



TYPE "TG"
TANGENT CHASER
DIE HEAD



By the publishers of
MACHINERY'S HANDBOOK

MACHINE SHOP

The complete course, published 1940, is in two volumes. The subjects covered by each volume are listed below. Either volume may be obtained and used independently of the other; but if both books are purchased together, you not only will save money, but possess the most complete existing treatise on machine shop practice and allied subjects. These books explain **HOW** and **WHY**—they give facts and the reasons back of them.

GENERAL OUTLINE OF CONTENTS

Volume I—474 pages

Principles Underlying All Metal-Cutting Operations
Lathes and Their Principal Mechanical Features
Turning Cylindrical Parts in Lathe
Taper Turning in Lathe and Taper Attachments
Use of Chucks and Faceplates; Drilling and Boring in Lathe
Single-Point Tool Forms and Tool Grinding
Principles Governing Speeds and Feeds for Metal Cutting
Cooling and Lubricating Fluids for Metal-Cutting Tools
Screw Thread Standards and Their Application
Cutting Screw Threads in the Lathe
How to Calculate Change Gears for Cutting Screw Threads
Measuring Pitch Diameters of Screw Threads
Turret Lathes and Machines of Automatic Type
Vertical Boring and Turning Machines
General Practice in Drilling and Reaming Holes
Precision Methods of Spacing or Locating Holes
Cylinder Boring and Precision Jig Boring
Controlling Degree of Accuracy in Interchangeable Manufacture
Different Classes of Fits for Machine Parts
Calipers, Micrometers and Other Measuring Instruments
Fixed Gages for Checking the Sizes of Duplicate Parts
Gaging Tapering Parts and Measuring Angles
Precision Gage-Blocks and Their Application
Generating Plane Surfaces and Angles

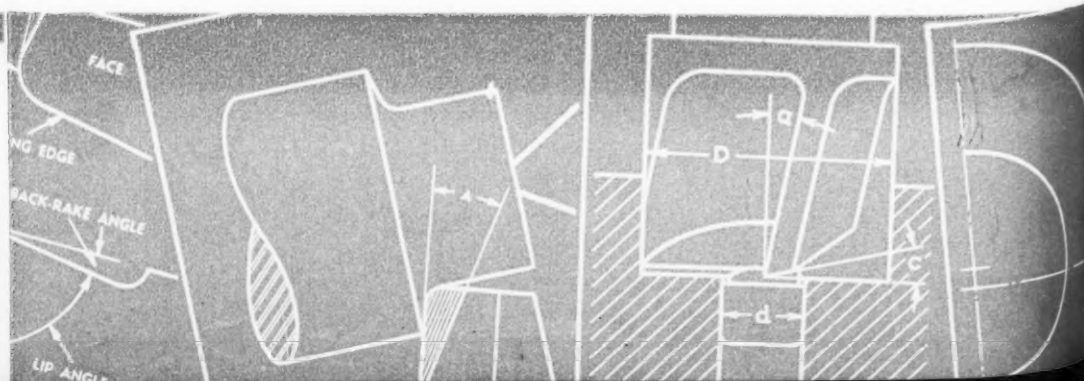
Volume II—552 pages

Cutting Threads in Holes by Tapping
Cutting External Screw Threads with Dies
Forming Screw Threads by Milling and Grinding
Forming Screw Threads by Rolling Process
Planing Process and Its General Application
Milling Flat, Curved and Irregular Surfaces
Dividing Circumferences into Equal Parts by Indexing
Generating Helical Grooves with Index-Head
Operations Requiring Angular Adjustment of Index-Head
Milling Irregular Contours by Reproducing Shape of Model
Cutting Spur Gears with Formed Cutters
Milling Bevel, Helical and Worm-Gears
Cutting Very Large Spur Gears and Bevel Gears
Generating Methods of Forming Gear Teeth
Grinding Cylindrical and Tapering Parts
Surface Grinding and Types of Machines Used
Internal Grinding Including Centerless Method
Grinding Milling Cutters and Reamers
Lapping and Other Precision Finishing Processes
Broaching Internal and External Surfaces
Chipping, Filing, Scraping and Hand Grinding
Tool Steels and Other Metal-Cutting Materials
Heat-Treatment of Steels for Metal-Cutting Tools
Definitions of Shop Terms in General Use

**MACHINE SHOP
TRAINING COURSE**

is illustrated by

430 Drawings and
Photographs



TRAINING COURSE

For the Shop Man Who Wants to Know How and Why

The MACHINE SHOP TRAINING COURSE is for the machinist or machine operator who wants to be shown how and why whenever any shop problem arises that he doesn't understand thoroughly. Even experienced men will find in this great treatise a lot of practical and useful information. These books record in simple language what many specialists in the machine shop and tool-room have found from actual experience to be well worth knowing.

For Training Skilled Workmen

Training competent men for the machine shop is costly in time and also in money when the lack of properly trained men is taken into account. Here is a practical way of securing a decided improvement in the general quality of shop training courses—all for an additional total cost of only \$6 per man. Place into each man's hands the complete two-volume MACHINE SHOP TRAINING COURSE described on the preceding pages. This treatise "steps up" a training course and greatly assists in turning out USEFUL workmen in much less time than by the old hit-or-miss instruction methods.

For Designers Who Want the Fundamentals of Shop Practice

Designing machines or their parts on paper is one thing—producing them is another. The competent designer builds on paper to suit the best available production methods. To do this, he must know about different types of machine tools, how they are applied, and understand the principles governing the selection of different types when more than one type might be used. If you have not graduated from the shop (or even if you have), make this experiment: Study carefully every one of the 48 sections in the MACHINE SHOP TRAINING COURSE and add all of this practical information to your own "stock in trade."

For Technical or Trade Schools

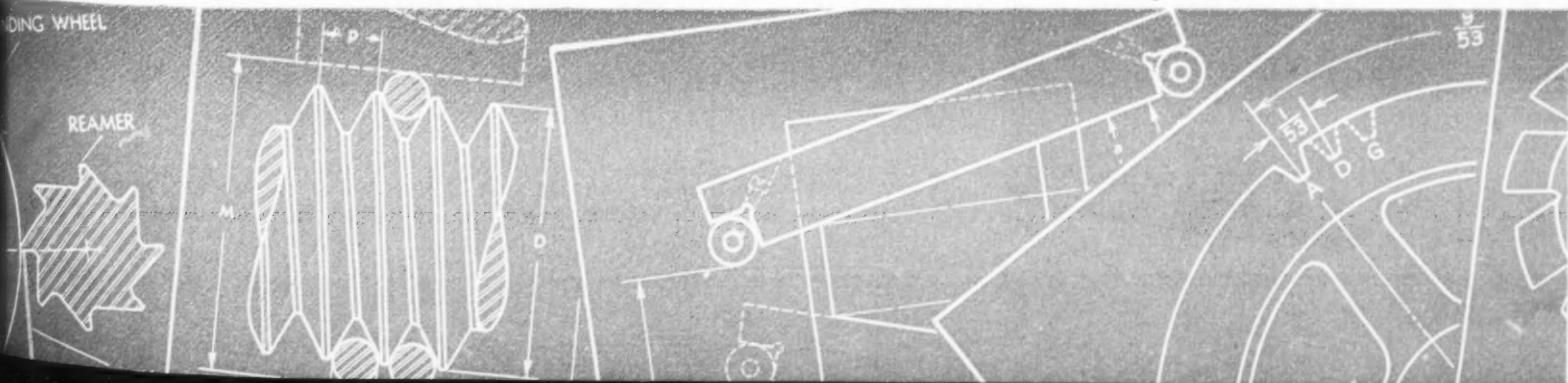
In technical or trade schools, a first-class textbook is a very important part of the equipment. The MACHINE SHOP TRAINING COURSE is especially designed for such use. This unusually complete treatise gives the students in a school shop the kind of practice and information that is actually applied daily in commercial machine shops and manufacturing plants. Graduates from schools using these books are bound to have a broad foundation of shop practice knowledge.

For Mechanical Engineering Students

If you are naturally inclined toward things mechanical and intend to become a mechanical engineer or possibly an engineering or manufacturing executive some day, your training, even if in a college or university, will always be a lot stronger if backed up with practical knowledge of the foundation principles underlying machine shop and manufacturing practice. The MACHINE SHOP TRAINING COURSE will give you an exceptionally complete insight into the principles, methods and tool equipment that are actually being applied today in every type of shop or plant.

Give Yourself This Practical Test

Get both volumes of the MACHINE SHOP TRAINING COURSE. If you are experienced in shop practice, skip the elementary questions but try to answer definitely all of the others. Give these books a real "workout"; then ask yourself this question: Where is there a treatise on machine shop practice that is in the same class when judged by its usefulness, completeness, clearness, or practical value? The entire two-volume course contains 1026 pages of condensed information all in simple understandable language; 430 drawings and photographs; and 330 definitions of important shop terms in common use.



Single-Point Tool Forms and Tool Grinding

408

FIXED GAGES

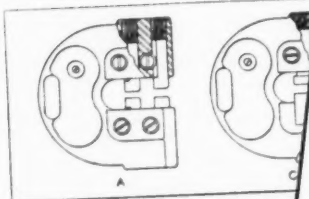


Fig. 3. Snap Gage of Standard Deal

380

CLASSES OF FITS

How are very low temperatures used for obtaining expansion fits or the reverse of shrinkage fitting?

432

MEASURING TAPERING PARTS AND ANGLES

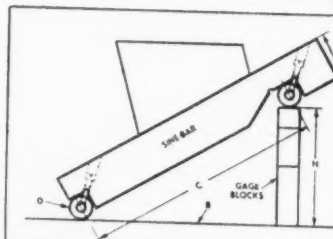


Fig. 11. Setting Sine-bar to Given Angle A

376

CLASSES OF FITS

Record of Assembling Pressures for Force

[illegible]

In manufacturing duplicate machines or other mechanisms, two general methods of procedure are possible. One method is to build each machine independently, the others in obtaining the necessary fits between the different parts. For instance, in manufacturing a given lot of machines, some part such as a bearing, for example, might be fitted to its shaft in order to obtain the quality of fit required. Let us assume that this same individual fitting job is done on each machine and without attempting to use bearings or shafts sufficiently uniform to make them interchangeable on any of the various machines in a given lot. If this practice were followed, the bearing would be suitable for its own particular shaft and machine, and it could not be on another machine unless it happened to be of the right size.

Most of the screw threads used in machine construction conform to some established standard. These standards include the profile or cross-sectional shape, a range of screw thread diameters, and the number of threads per inch for each diameter. Tolerances and allowances for obtaining varying degrees of fit and different classes of fits are also included in the screw thread standardization. While screw threads, in general, conform to some standard, a screw thread may be standard as to thread form but not standard as to number of threads per inch. These special screws are used when there is some mechanical advantage in using a thread that is smaller in pitch than the standard adjustment is required.

234

MEASURING SCREW THREADS

Why is the pitch diameter a very important dimension?

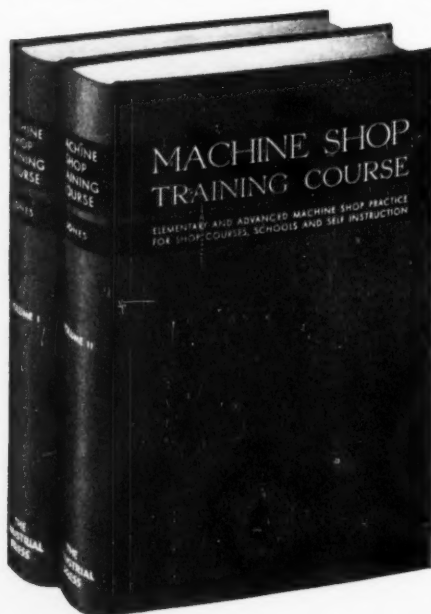
440

PRECISION GAGE-BLOCKS

variation. In other words, precision gage-blocks are practically errorless. Many gage-blocks do not vary from the given size more than two millionths of an inch. The measuring surfaces are not only exact as to the distance between them, but these surfaces must also be flat and parallel with practically no error. Gage-blocks are sold in sets. By combining two or more precision gage-blocks (as explained later) a large range of extremely accurate dimensions can be obtained. The blocks are combined in this way when there is no single block in the set of exactly the size wanted. Gage-blocks or combinations of them are very generally used in machine building plants as ultimate standards of reference for checking inspection or working gages and other precise measuring and gaging equipment.

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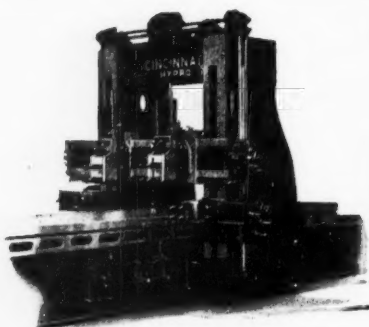
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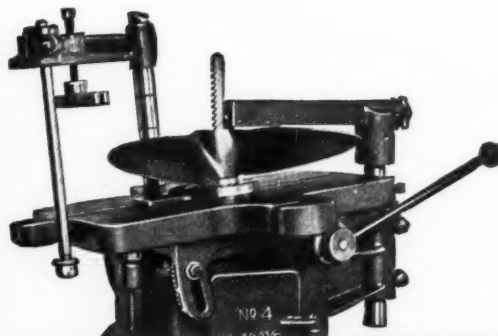
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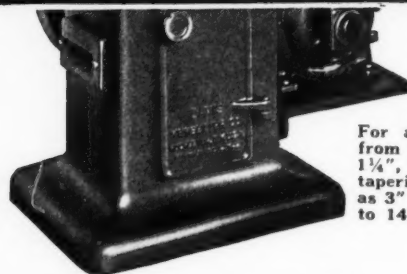
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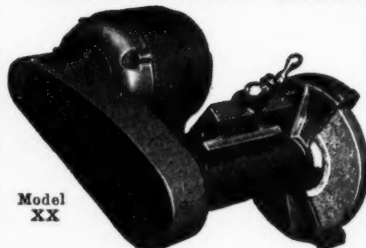
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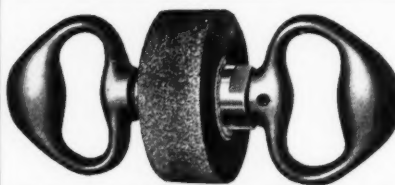


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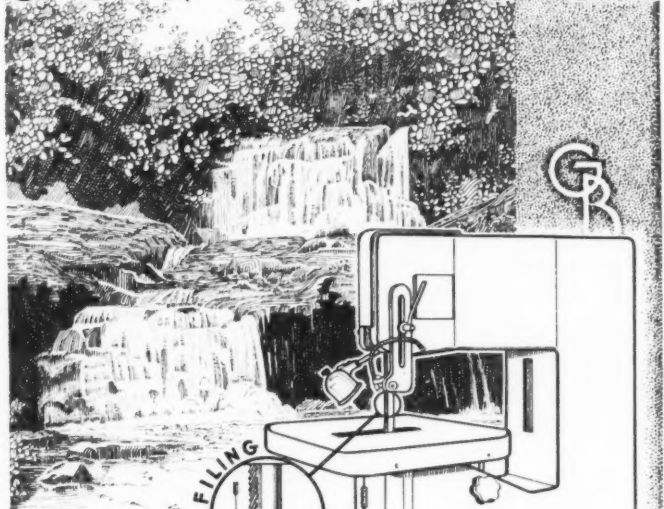


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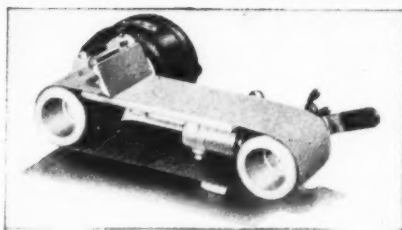
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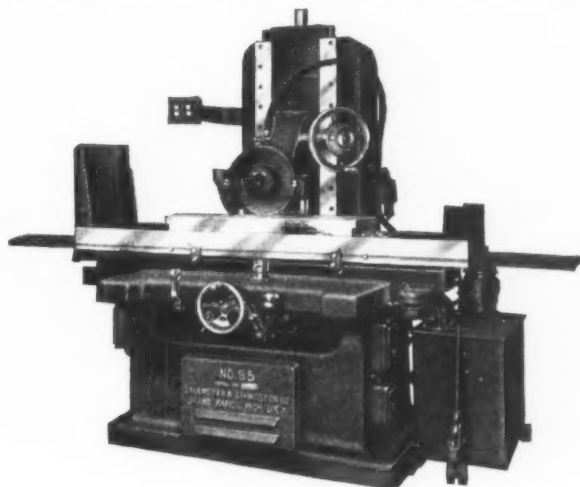
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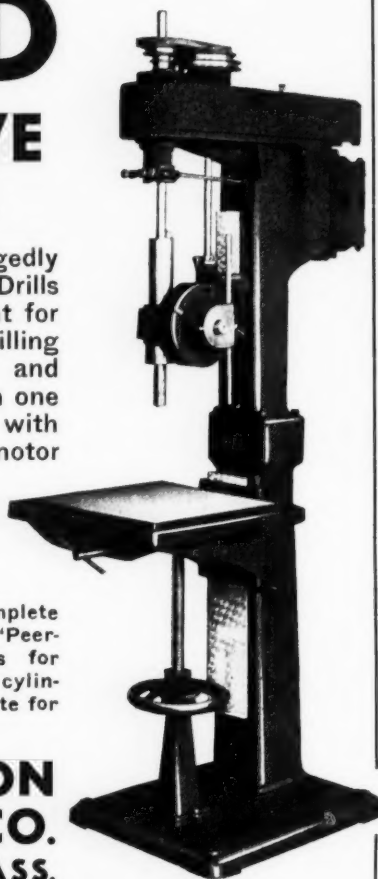
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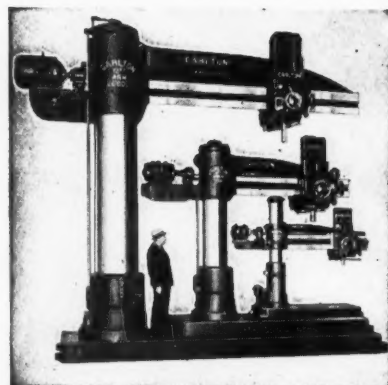
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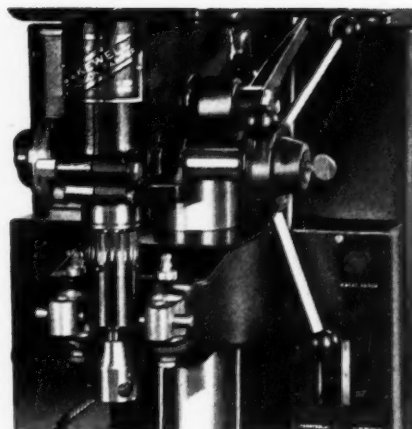
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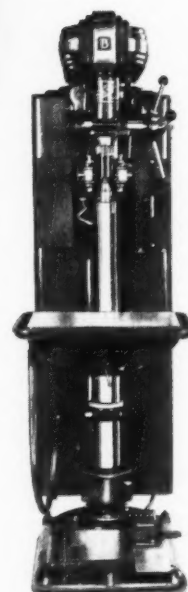
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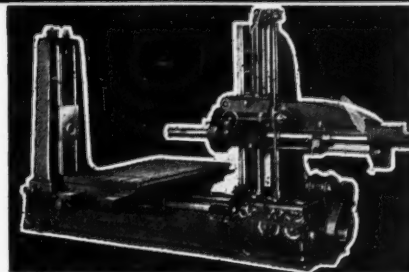
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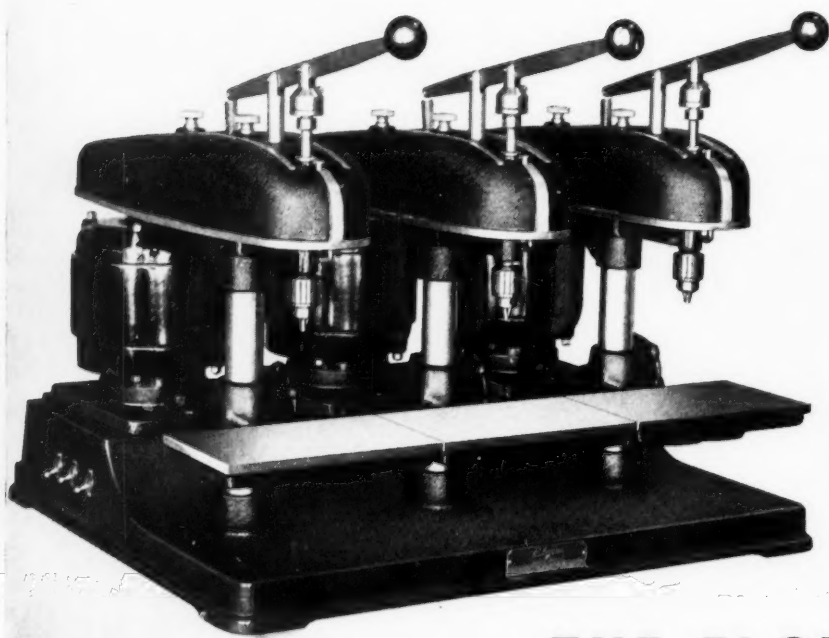
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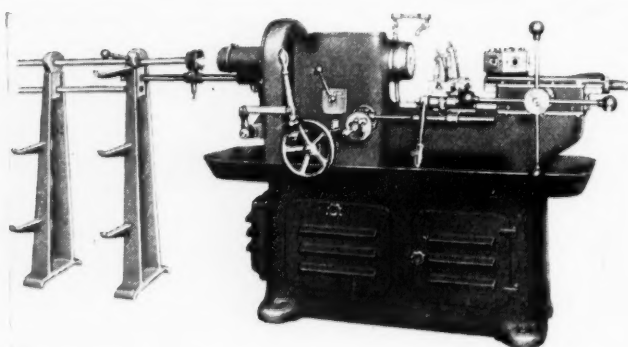
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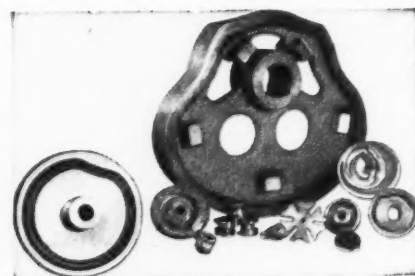
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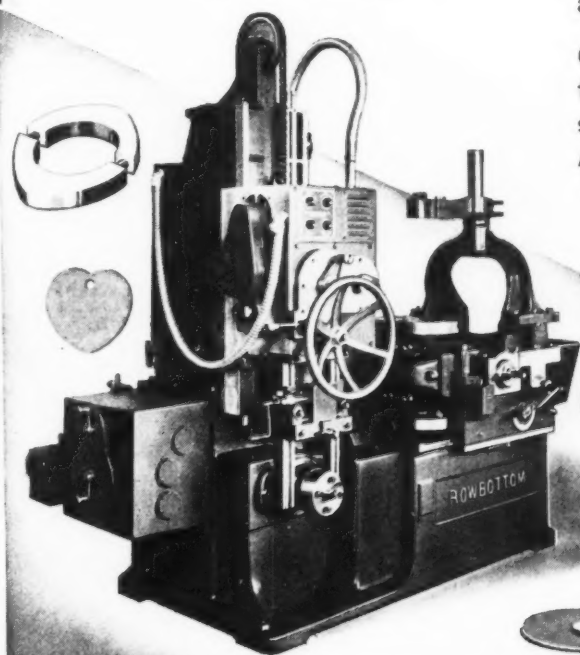
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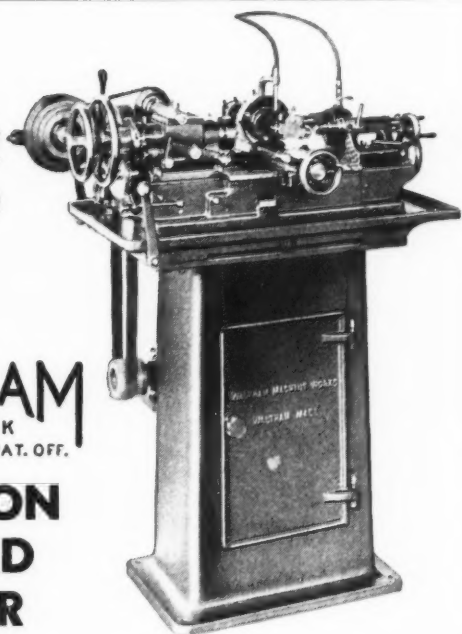


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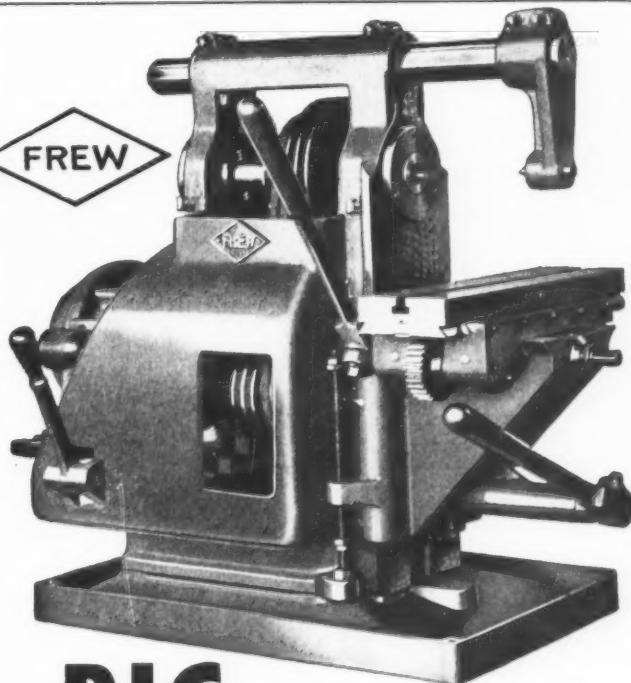


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CHUCKING MACHINES

Four, Five, Six, Eight Spindles • Work and Tool Rotating Types,
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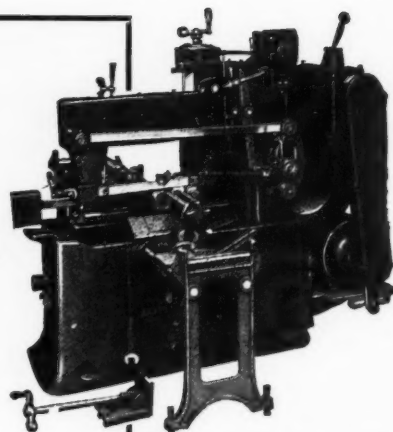
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Capacity 10" x 10"

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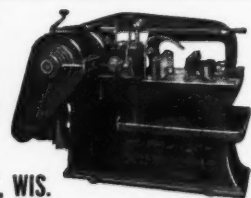
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17 STYLES AND SIZES MERRELL PIPE THREADING MACHINES TOLEDO, OHIO

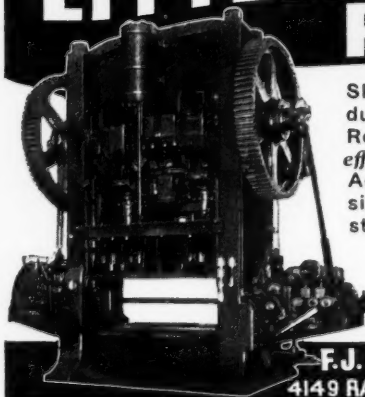
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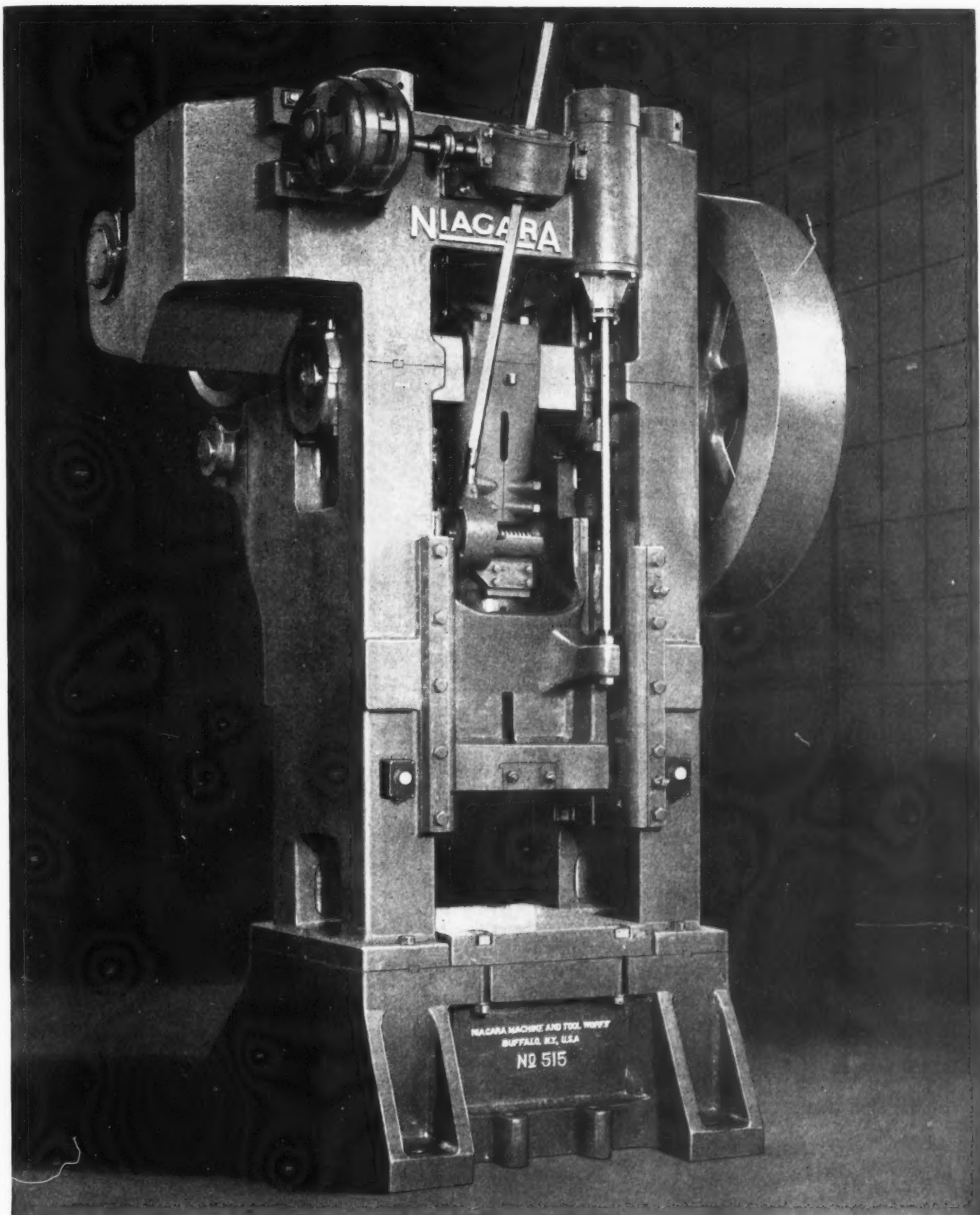


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These Turret Punch Presses by Wiedemann are deep-throated, large capacity machines designed for rapid, continuous duty. No interference from adjacent punches and dies, because only one station can be in operation at one time. All die holders are plainly marked with diameters and maximum thickness of sheets for which they are intended. Alloy steel and chrome vanadium steel on vital parts. These presses are thoroughly dependable for speed and profitable high production.

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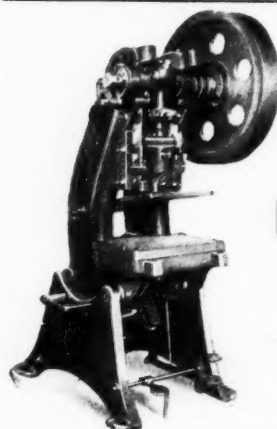


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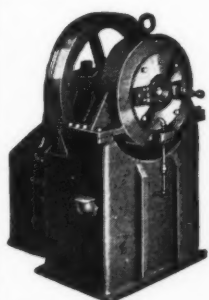


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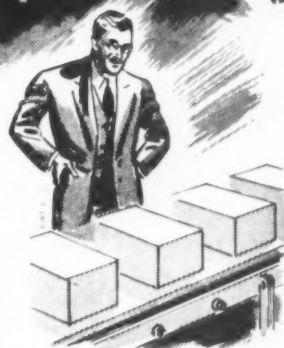
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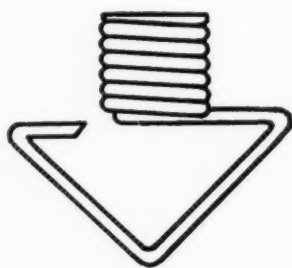


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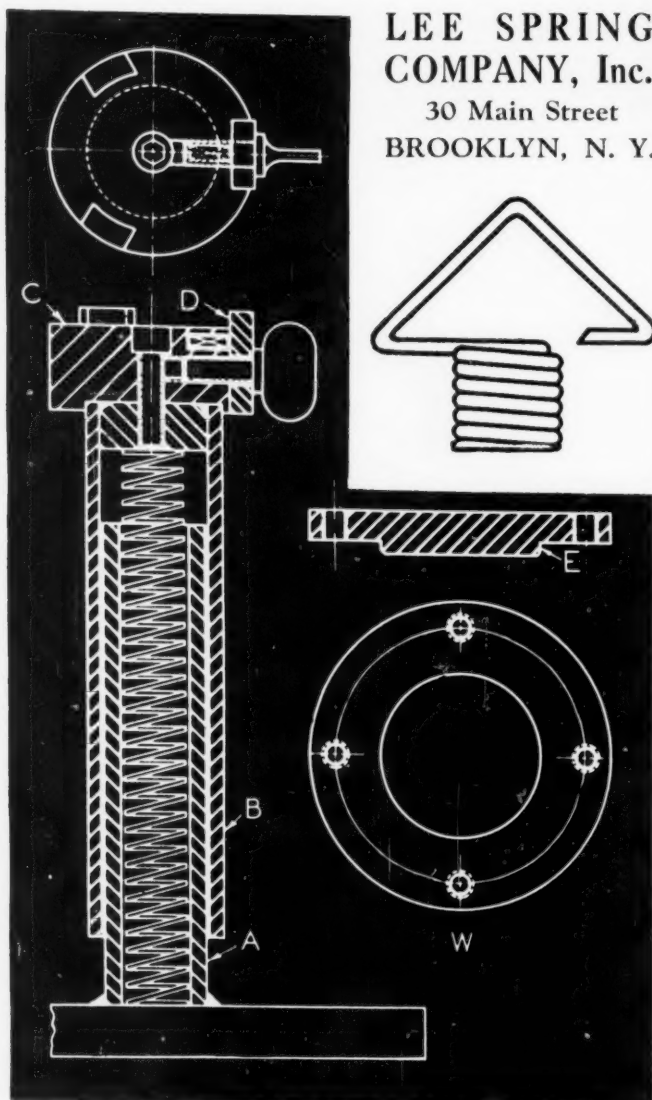
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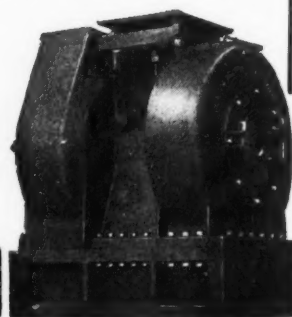


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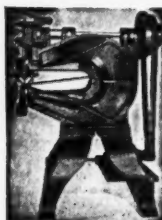
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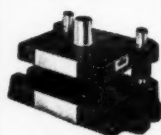
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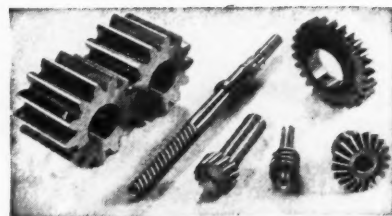


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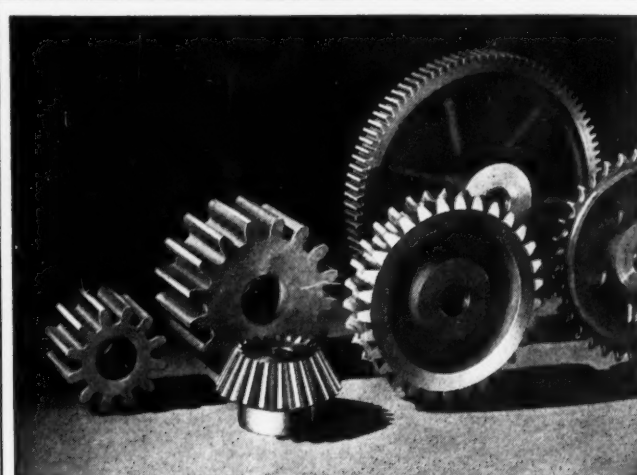
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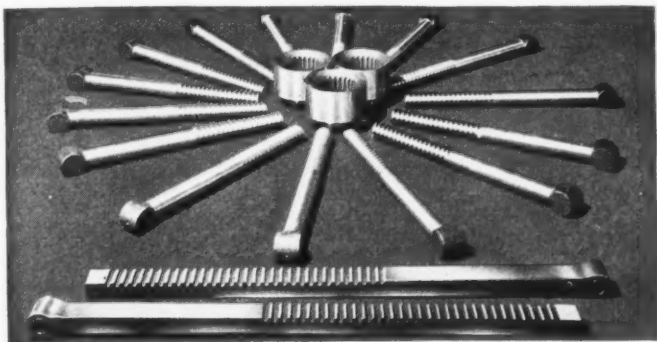
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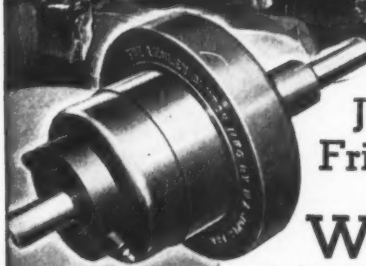
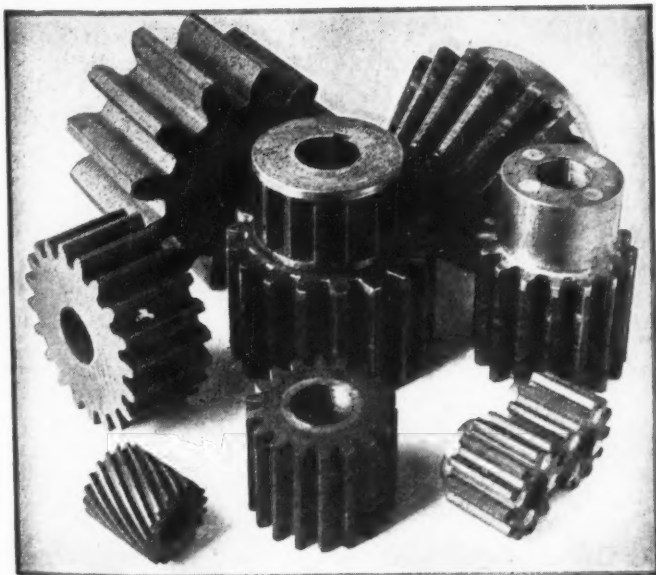
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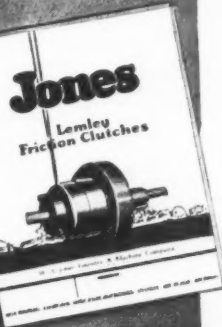
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COMPLETE CLUTCH INFORMATION

Sizes, ratings, dimensions, prices and other data are contained in Bulletin No. 60 covering Jones-Lemley friction clutches and clutch pulleys.

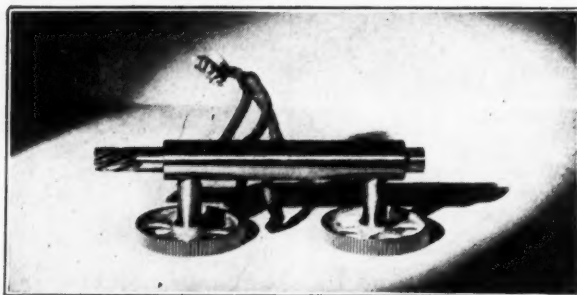
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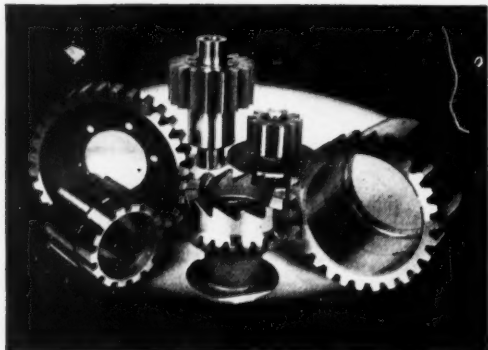
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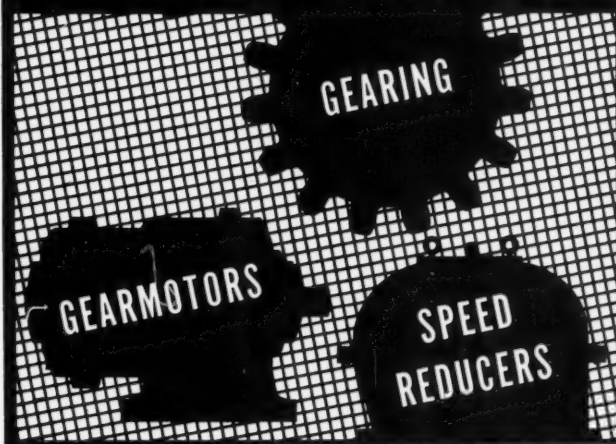
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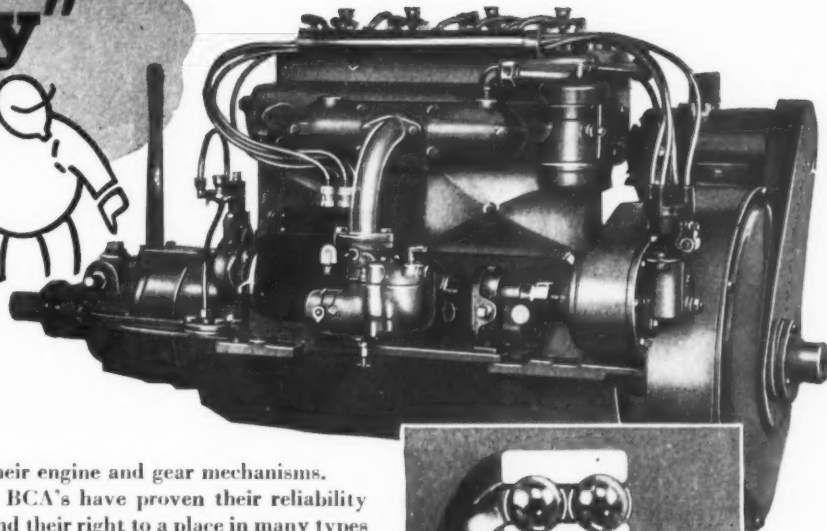
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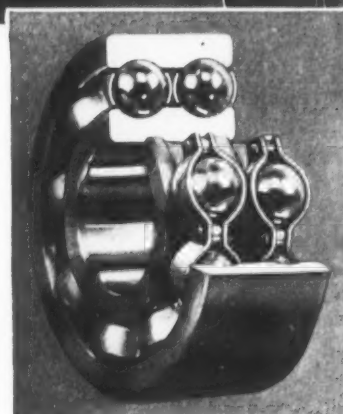


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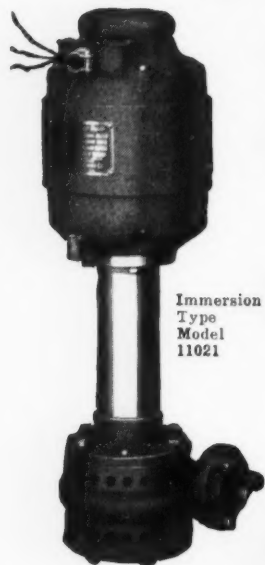
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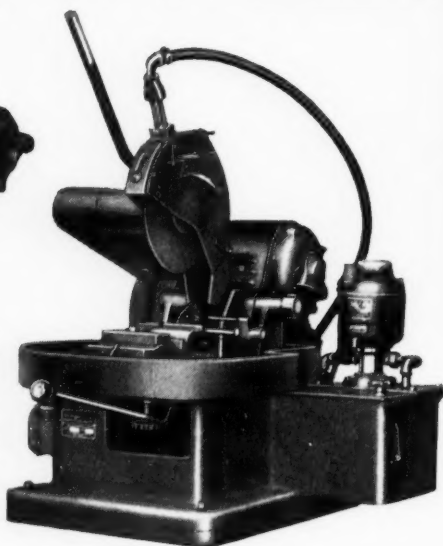
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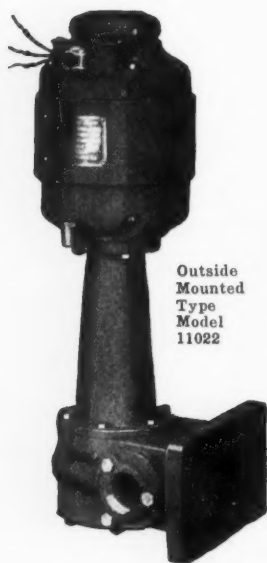


Immersion
Type
Model
11021

How to CUT OUT
Coolant Troubles
... in ...
CUT-OFF Machines



Bridgeport "Abrasive"
Wet Cut-Off Machine
manufactured by the
Bridgeport Safety
Emery Wheel Co. and
fitted with a Gusher
Coolant Pump as
standard equipment.



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11022

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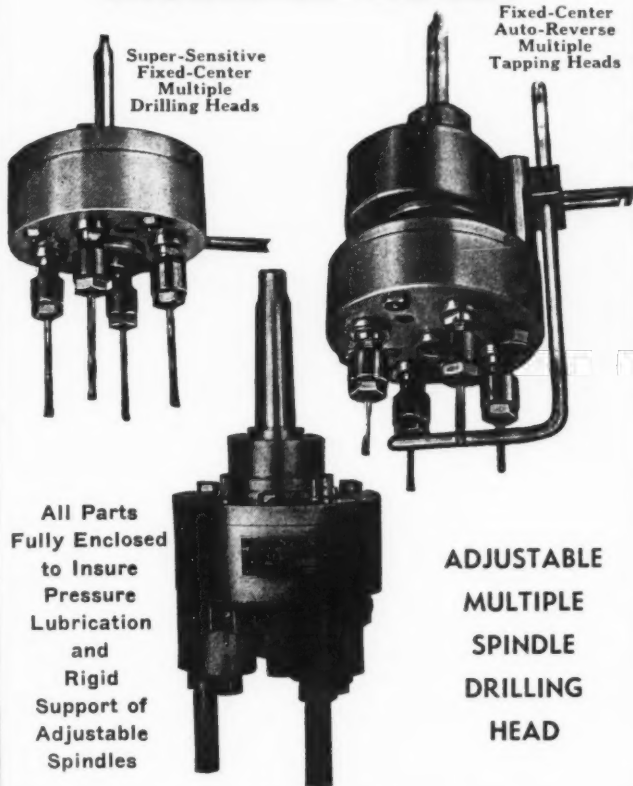
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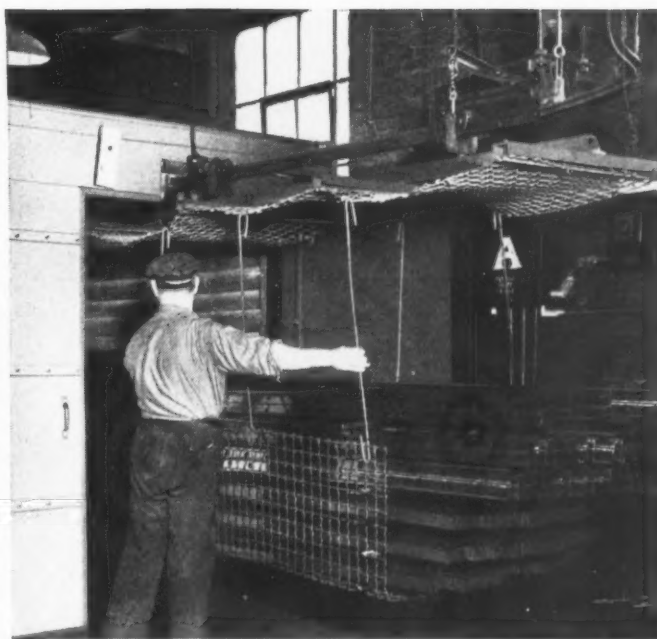
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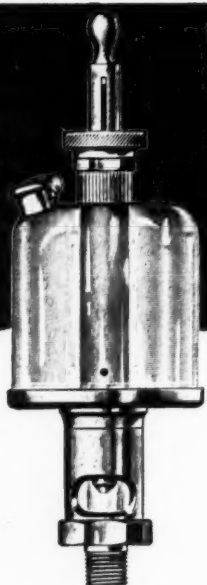
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CLEVELAND, OHIO

**LUBRI
ZOL**
REG. U.S. PAT. OFF.

OIL when
and as you
need it!

GITS

unbreakable
SIGHT GRAVITY
NEEDLE VALVE
ADJUSTMENT
FEED OILER

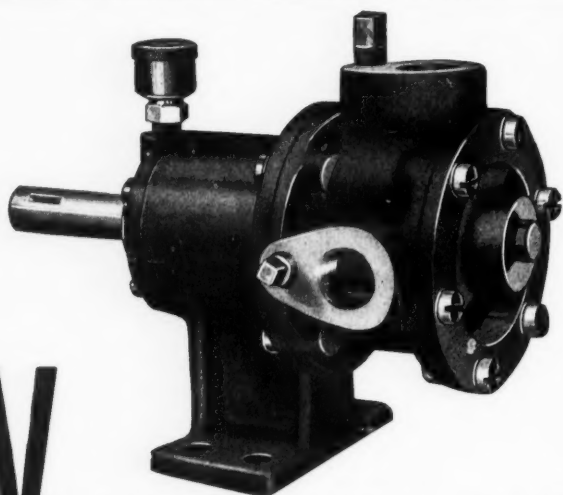


Oil flow may be adjusted as desired, or completely shut off by adjustable needle valve. Modern, streamline, unbreakable bottle eliminates danger of broken glass in production.

GITS BROS. MFG. CO.

1858 S. Kilbourn Ave. Chicago

30 years of oil cup experience



VIKING COOLANT PUMPS



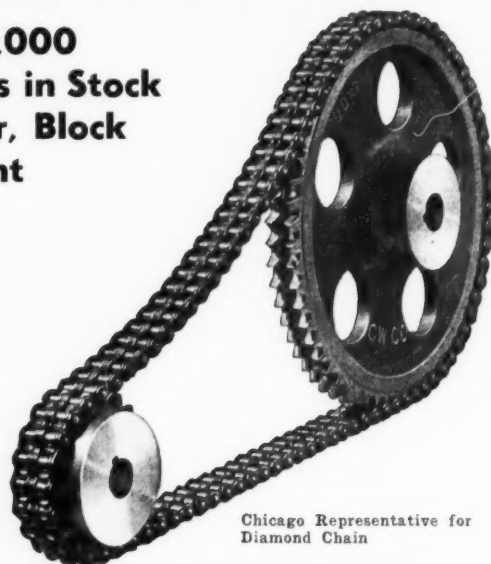
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YOUR
GUARANTEE

An outstanding feature of the Viking Coolant Pump is the flexible casing . . . by merely removing four bracket bolts, the casing can be easily rotated to any desired position. This guarantees a quicker, sturdier installation. Five capacities are available —5, 10, 15, 20 and 35 G.P.M. Bulletin 1100-32 gives complete specifications. . . write for a copy.

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CEDAR FALLS IOWA

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Over 45,000
Sprockets in Stock
for Roller, Block
and Silent
Chains



Chicago Representative for
Diamond Chain

Write for Sprocket Book

CULLMAN WHEEL COMPANY

1339 Altgeld Street, CHICAGO, ILL.

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THE HILLIARD OVER-RUNNING CLUTCH...

Four important functions:

- automatic dual drive operation of any equipment with any type of prime movers
- automatic operation of 2-speed drive
- as a ratchet, permitting infinite adjustment
- as an automatic back-stop

Write for booklet giving full information

THERE'S A HILLIARD CLUTCH FOR EVERY JOB
OVER-RUNNING...FRICTION...SINGLE REVOLUTION...SLIP...SPECIAL

THE HILLIARD CORPORATION

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ELMIRA, N. Y.

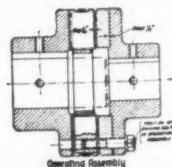
CHICAGO OFFICE: 201 NORTH WELLS STREET

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Easy To Get At!

L-R Type WQ permits rotation of either shaft, timing of engine or renewal of either element without tear-down of coupling or moving machine.

Time-saving, non-lubricated coupling available with bores up to 14". Catalog ready, free—Write.



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Heavy Duty Thrust Bearings



STANDARD SIZES or
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THE GWILLIAM CO., 360 Furman St., Brooklyn, N.Y.



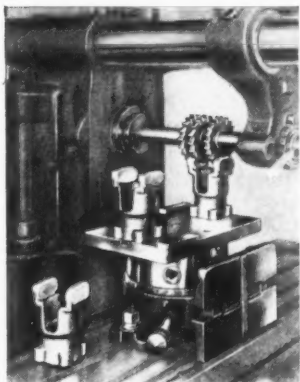
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BETTER
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THE HARTFORD SUPERSPACER

Use it for drilling accurately located holes in any division of 2, 3, 4, 6, 8, 12, 24 . . . for milling one part while another is being made ready. Use it vertically or horizontally on any machine table.

The Superspacer's rugged construction and foolproof system of indexing eliminates errors and helps to improve accuracy.

Write for booklet illustrating its many unique possibilities on all types of work.



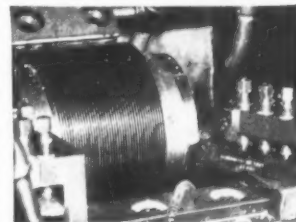
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HARTFORD, CONN.

SPEED UP NATIONAL DEFENSE with **KENNAMETAL** steel-cutting

Scores of plants producing airplane parts, tanks, guns, shells and other armaments are now speeding up production with KENNAMETAL-tipped tools. Wright Aeronautical Corp., for example, specify KENNAMETAL on most steel cutting jobs in their Paterson, N. J., plant.

KENNAMETAL is also reducing machining time of parts for trucks, tractors, railroad cars, locomotives and other auxiliary equipment so vital to National Defense.

Let us show you how KENNAMETAL can increase your production of hard steel parts from 30 to 50%—*with no additions to your present machine tool investment.* There is no obligation—write today.



Turning Nitralloy steel cylinder barrels (230-240 Brinell) for "Cyclone" engines at Wright Aeronautical Corp. Speed, 200 ft. per min.

carbide tools

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LATROBE, PENNSYLVANIA, U.S.A.

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One of the recognized bottlenecks in national defense is an acute shortage of skilled tool and die makers. Are you conducting a training course or planning to start one to help solve this urgent problem in your plant? If so, here is a modern, up-to-date text that makes teaching easier.

TOOL STEEL SIMPLIFIED

By Frank R. Palmer
Assistant to the President
The Carpenter Steel Company
315 pages — 205 illustrations

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Now in use in many vocational and trade schools, and in apprentice courses conducted by industrial plants. Elementary enough to meet the urgent need for a good text for apprentice training. Practical enough to be helpful in advancing the skilled tool maker. Contains hundreds of practical suggestions that can be quickly applied in daily work to get improved tool performance. Send coupon below for free descriptive leaflet, or order a book for examination.

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... Simple and easy to read. Contains useful information which commends it to technical men, semi-technical men, and men in the shops who want to improve their ability to make the best use of tools.
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Dept. of Metallurgical Engineering
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Supervisor Industrial Education
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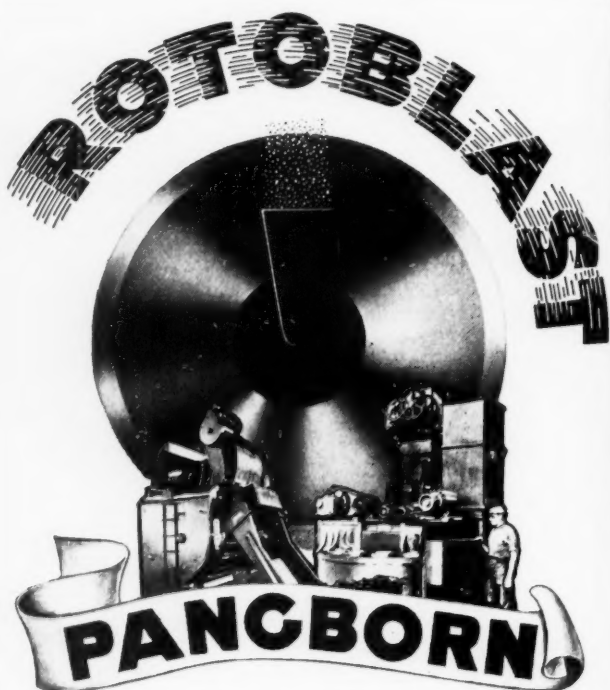
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Behind the rising popularity of Pangborn Blast Cleaning Tables, Barrels and Special Machines, is the solid satisfaction and perfection of the ROTOBLAST.

The ROTOBLAST gives you a fast and efficient blast cleaning unit that economically removes scale, dirt and sand from big and little castings by centrifugal force . . . eliminating the need for compressed air.

The Pangborn ROTOBLAST has no useless parts to wear, no elaborate assembly to add to its maintenance. It is a true precision unit, smooth running at its maximum 2400 RPM, and develops a superior striking power by its elimination of an impeller in the abrasive path from feed center to the vanes.

The ROTOBLAST has been subjected to every test . . . and comes up with unusual distinction. Industry recognizes this triumph and today awards Pangborn by placing more and larger orders for Pangborn Barrels, Tables and Special Machines than ever before in our history.

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WORLD'S LARGEST MANUFACTURER OF BLAST
CLEANING AND DUST CONTROL EQUIPMENT

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HY-TEN

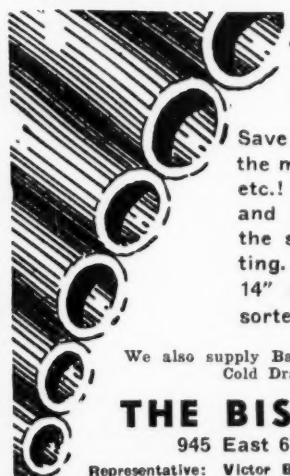
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COMPLETELY STOCKED
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A letter, 'phone call or telegram
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and be prepared when you need
steel in a hurry.

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Save in time and material! Speed up the making of rings, spacers, bushings, etc.! Use BISCO Tool Steel TUBING and eliminate wasteful drilling from the solid; slow, tedious filing and fitting. All sizes up to 2" wall thickness, 14" diameter. Keep a supply of assorted sizes always on hand.

We also supply Ball Bearing, Aircraft, Mechanical, Pressure, Cold Drawn, Boiler and Stainless Tubes.

THE BISSETT STEEL CO.

945 East 67th St., CLEVELAND, OHIO

Representative: Victor Brook, 433 Rockingham St., Rochester, N. Y.



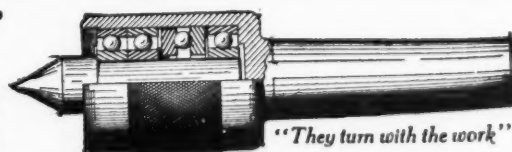
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Ball
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Centers



MODERN MACHINE CORP., 323 Berry St., Brooklyn, N.Y.

Getting Salesmen's Co-operation

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DIRECT MAIL

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Market Information

contributing to the solution
of general company problems

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ALLOCATION OF BUDGETS

Programs that management
will approve

WHAT'S YOUR PROBLEM?

Your business . . . in at least one respect . . . is no different from others: *Your marketing problems are constantly changing.* You must ever be on the search for new ideas . . . for new ways to get results.

No doubt several of your immediate problems are indicated here . . . all of those shown will be threshed out at the 18th Annual Conference and Exposition of the National Industrial Advertisers Association, at the Hotel Statler, Detroit, September 18, 19, 20.

Plan now to get the up-to-the-minute facts on the latest ways to do a better industrial marketing and advertising job.

*All Industrial Marketing Executives
are invited to this Conference*



1940 INDUSTRIAL ADVERTISING CONFERENCE

DETROIT . . . HOTEL STATLER . . . SEPTEMBER 18, 19, 20

CLASSIFIED AND RE-SALE

Rates for Advertisements—\$6.50 Column Inch Each Insertion

EMCO REBUILT MACHINE TOOLS

BORING MILLS

2—72" Cincinnati Rapid Production, M.D., P.R.T., 2 heads
70" Niles, cone
52" Niles, M.D., 2 heads, P.R.T.
42" King, M.D., 2 rail heads, 1 side head, P.R.T.
42" Colburn, M.D., 2 rail heads, P.R.T.
42" Gisholt, gear box, 2 heads
No. 40 Landis Floor Type, 4" bar
No. 4 Niles-Bement-Pond Horizontal, 5 1/2" bar
Niles-Bement-Pond Cylinder Borer, 12" main bar

BROACHING MACHINES

No. 1 J. N. LaPointe, belt
No. 2 J. N. LaPointe, M.D.
No. 2 J. N. LaPointe, belt
No. 3 J. N. LaPointe Double, belt
No. 3B J. N. LaPointe, gear box
No. 3B J. N. LaPointe, belt
Oilgear Type XB-10 Twin Ten Hydraulic, M.D.
15 ton Hercules, M.D.

SQUARE SHEARS

KL 10 1/2 Niagara, M.D., cap. 10' by 3/4", 1 t.

MILLING MACHINES

No. 2H Brown & Sharpe Plain, cone
No. 2 Cincinnati Plain, cone
No. 2 Cleveland Plain, S.P.D.
No. 2 Van Norman Duplex, belt
No. 3 Hendey-Norton Plain, cone
No. 3 Kempsmith Plain, cone
No. 4 Cincinnati Plain, cone
No. 13B Brown & Sharpe, S.P.D.
No. 25 Becker Plain, cone
No. 2A, 4B, 5C, 6 Becker Vertical, cone
No. 3 Cincinnati Vertical, S.P.D., flanged spindle
48" Cincinnati Worm Driven Plain Automatic, M.D.
24" Cincinnati Duplex Automatic, belt
No. 4—36" Cincinnati Plain Hydromatic, M.D., in base
36"x36"x8" Ingersoll, belt
48" Osterlein Tilted Offset, M.D., Tinken Bearings
No. 7H Becker Lincoln Type
Gooley & Edlund Briggs Type
No. 606A Newton 3 spindle Continuous, S.P.D.
Putnam Briggs Type, belt

We carry an average stock of 1500 machines. Send us your inquiries.

GRINDERS

No. 16—26" Blanchard Vertical Surface, 25 H.P. motor on spindle, late type
No. 10F Norton Lapper, M.D.
12"x36" Diamond Auto. Surface, M.D.
18"x48" Diamond L.D. Face, M.D.
30"x84" Diamond H.D. Face, M.D.
60" Bridgeport Face, S.P.D.
Springfield Planer Type Surface, M.D.
No. 3 Bryant Semi-Automatic Hole, M.D.
No. 10 Bryant Internal, belt
No. 11 Giddings & Lewis Teromatic, 3 M.D.
5 H.P. Hisey-Wolf B.B. Polishing Stand
5 H.P. Mitchell Type A1 B.B. Polishing Stand
U. S. Elec. Tool Polishing Stand
No. 1, 1 1/2 Cincinnati Universal Tool & Cutter, belt
No. 1 LeBlond Universal Tool & Cutter, M.D.
No. 1 Wilmarth & Morman Universal, M.D.
No. 2 Brown & Sharpe Universal, belt
No. 2 Landis Universal, belt
No. 3A—16x48" Cincinnati Universal, belt
6x18" Landis Plain Cylindrical, M.D.
No. 11 Brown & Sharpe Plain Self-Contained, S.P.D.
6x30", 6x32", 10x36", 10x50", 14x72" Norton, motor and belt driven types
10x36" Landis Integral Cam, M.D.
10x52", 10x72" Landis Plain Cylindrical, M.D.
12x18" Cincinnati Plunge Cut, M.D.
12x72" Landis Plain Cylindrical, M.D.
16x52", 16x72" Landis Plain Cylindrical, M.D.
20x144" Landis Plain Cylindrical, M.D.
No. 4, 6 Gardner B.B. Disc, M.D.
No. 20 Gardner B.B. Combination Disc & Roll
No. 51 Besley Disc, M.D.
No. 120 Gardner Disc, belt

PLANERS

Morton Traveling Head, M.D., 48" stroke
24" Cincinnati Crank, M.D.
24"x24"x6" Ohio, belt
24"x24"x6" Smith & Silk, M.D.
30"x30"x8" Pond, belt
30"x30"x12" G. A. Gray, belted M.D.
32"x32"x8" Gray, belt
36"x36"x10" Niles, reversing M.D., 3 heads
36"x36"x12" Niles, M.D., 4 heads
36" widened to 42"x12" Cincinnati, reversing M.D., 3 heads
39"x39"x10" Cincinnati Forge, belt
54"x42"x12" Gray, reversing M.D., 4 heads
55"x55"x30" Betts, reversing M.D., 2 heads

CIMSCO

Rebuilt Machine Tools

LATHES

18"x8' Monarch Grd. Hd., M.D.
2—18"x8' Lodge & Shipley Grd. Hd., M.D.
21"x10' LeBlond, cone
20"x8' American, 3 S.C.D., D.B.G.
25"x12' LeBlond, 3 S.C.D., B.G.
30"x10' American Grd. Hd., M.D.
30"x20' American

RADIALS AND UPRIGHT DRILLS

2 1/2", 3", 3 1/2", 6" Cintl. Bick, S.P.D.
3, 4, 5 and 6" American Triple Purpose, S.P.D.
3" Mueller Plain, S.P.D.
24" Cincinnati Bickford Plain, Tapping

GEAR CUTTERS AND HOBBERS

Nos. 1 & 3 Adams Farwell Gear Hobbers
72" Gould & Eberhardt, Belt drive
6" Gleason Bevel Gear Generators
No. 2 and No. 3 Adams Farwell Hobbers
No. 3—36"; No. 4—36" B&S
11" Gleason Bevel Gear Generators
56" Rhenania Gear Hobbing Machine, C.D.

BORING MILLS

No. 1 Niles Horizontal Cone drive
42" Bullard Rapid Production, P.R.T. S.P.D.

SHAPERS AND PLANERS

16", 20" & 24" Gould & Eberhardt, high duty
26" Whipp Openside Crank Planer
24" Kelley Shaper
1—48"x48"x16" Pond, 4 heads

MILLING MACHINES

No. 3 Kempsmith Univ.
No. 4 Cincinnati Universal, three step cone
No. 3 LeBlond Heavy Duty, C.D.
No. 4 Cincinnati H.P. Plain S.P.D.
No. 2 Kempsmith, Plain, Self Contained, M.D.

GRINDERS

No. 16 Brown & Sharpe Plain
Nos. 50, 55, 60, 65 Healds
No. 33 Abrasive, M.D.
3" Pratt & Whitney Surf. Grinder
6x18, 12x36, 16x48 Landis S/C

MISCELLANEOUS

3" Landis Bit Cutter
2 1/2" Landis Single spindle, cone drive
2 1/2" Landis Bolt Cutter, Lead Screw
No. 10 Jackson Die Sinking Machine, M.D.
20x1 1/4" Bending Rolls, Arr. M.D.

If machines you need are not listed above, send us your inquiry. We have a very large stock.

Cincinnati Machinery & Supply Co.
217 E. Second St., Cincinnati, Ohio

THE EASTERN MACHINERY CO.

1006 TENNESSEE AVENUE, CINCINNATI, OHIO

IMMEDIATE DELIVERY

Model "J-D" Do-All Contour Machine.
26" Jarecki type BB Screw Press.
6"x6" Peerless High Speed Hack Saw.
Leeds-Northrup Hump Recording Controller.
No. 2 Leland Gifford 26" sgl. spl. Drill, M.D.
Oliver of Adrian Drill Grinder, M.D.
No. 5 Dumore Grinder.
Lindberg Electrically Controlled Tempering Furnace.

These tools are about 2 1/2 years old, have had only moderate use in high grade tool room. Excellent machines. Ask for details. May we send you our 28-page booklet?

MILES MACHINERY CO., Saginaw, Mich.

FOR SALE INGERSOLL MILLING MACHINE

30" x 30" x 24" with 20 H.P. A.C. G.E. motor.

Champlain Corp., Garfield, N. J.

FOR SALE: SMALL STAMPING and PLATING PLANT

Equipped with forge and die-making tools. Located in Jamestown, N. Y. Address Box No. 431, care MACHINERY, 148 Lafayette St., New York.

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Gray iron and alloyed iron. Up to 40 tons. Machine Tool, Pressure and gas tight castings. Complete pattern, machine shop, welding and pipe bending facilities.

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2126 S. First Street Milwaukee, Wis.

WANTED—MACHINE DESIGNER. Desirable position available with an Eastern machine tool building company for engineer who combines a thorough training in the practice of machine design with an interest in metal working manufacturing methods, which will enable him to develop an improved line of machines. Real opportunity for man with sound engineering training and bent for developing the art of metal manufacturing. Box No. 430, care MACHINERY, 148 Lafayette St., New York.

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Contact employers for positions through our confidential and effective methods. We negotiate preliminary overtures. Established 25 years. Inquiries invited.

H. H. Harrison, Director

The National Business Bourse
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USED and REBUILT**
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410 BROOME ST., NEW YORK

Do You Need Good Machinists, Draftsmen, Foremen?

Advertise for them in this
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LOVEJOY TOOL CO., INC.
SPRINGFIELD, VERMONT, U.S.A.
POSITIVE METAL CUTTING TOOLS LOCKED
INSERTED CUTTER TYPE
TURNING, BORING AND MILLING.

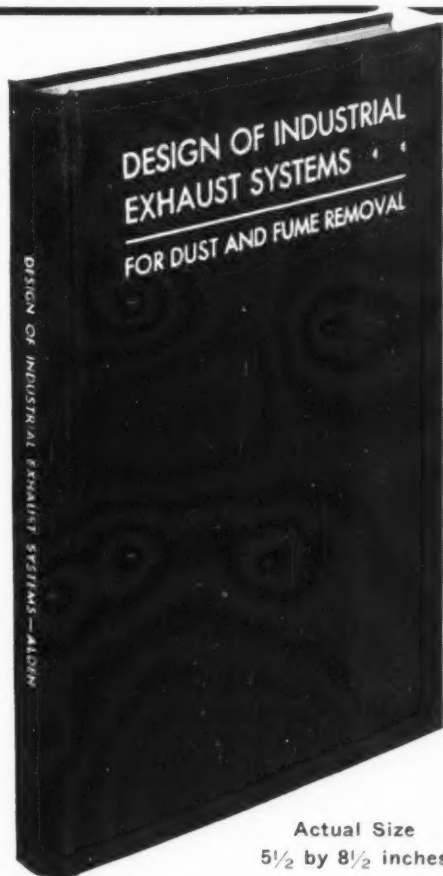
THE PRECISION UNIVERSAL TOOL HEAD
 brings all adjustments under absolute micrometric control of the operator without stopping tool or machine. In Jig Borer, Milling Machine or Horizontal Boring Mill, it bores, faces, counterbores, turns outside diameters, mills flat surfaces and slots, under-cuts, rebores, back-faces and does an almost limitless range of "headache" jobs. Send for bulletins.
Removal Notice We are no longer located at Bridgeport, Connecticut.
 Send all communications, inquiries and orders to
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 —Our Stock is Large and Varied
 —Our Prices Represent Real Values
SEND US YOUR INQUIRIES



Actual Size
 5½ by 8½ inches

HERE IS A LIST OF THE MAIN SUBJECTS:

Flow of Fluids.	Dust Separators.
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Pipe Resistance.	Structural Details.
Piping Design.	Field Measurements.

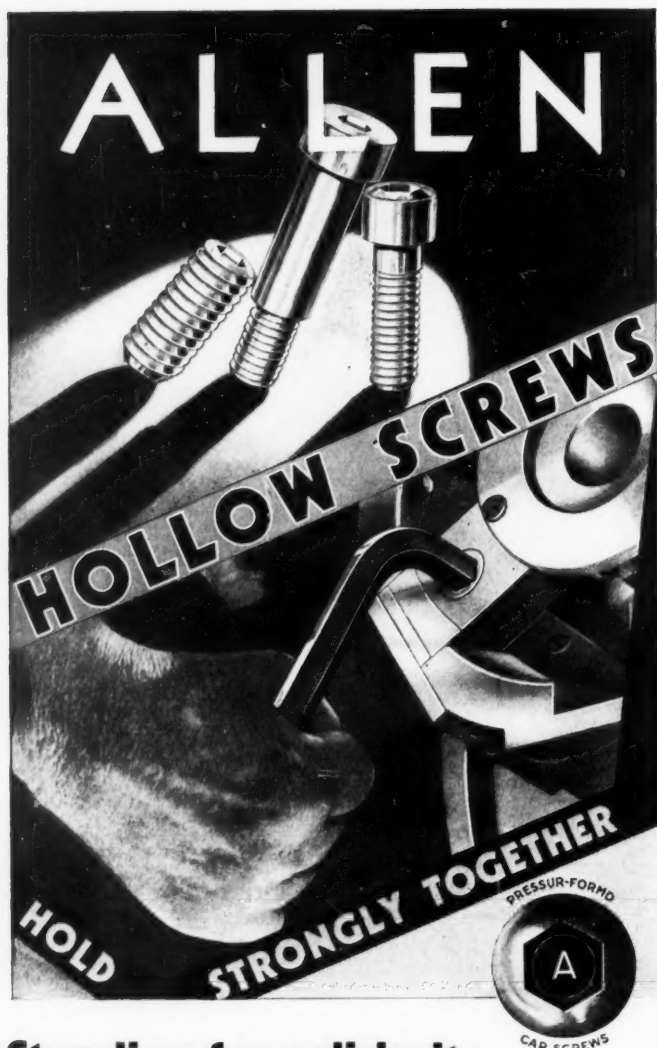
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This treatise on the "Design of Industrial Exhaust Systems" shows how to design, build, or buy an exhaust system that will remove dust, shavings, fumes, etc., so as to meet the requirements of the law or of industrial hygiene.

The descriptive matter is accompanied by 110 drawings and diagrams relating to the various details of exhaust system design. The author has aimed to dispel the mystery surrounding the design of exhaust systems and cover this subject in straightforward engineering terms. The book contains 215 pages of specific information and a lot of tabulated designing data of practical value. Price \$3.

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 148 Lafayette St., New York

M-8/40



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By what basic methods have "Allens" stood solid in the preference of design-engineers through three decades?

- (1) By *cold-drawing* of sockets, to increase the density of the steel in the socket-walls;
- (2) By *pressur-forming* of cap screws, to preserve continuous (uncut) steel fibres shaped to the contour of the screw head;
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- (4) By *heat-treating* individually according to size and style of point, to correctly balance the hardness and toughness in the right ratio for 95% of all uses;
- (5) By *instrument-testing* at every step, for each physical characteristic, with final hand-and-visual inspection of every screw.

We leave to you the interpretation of these operations in terms of **HOLDING POWER** of the product. So briefly stated, they're merely clues — worth following with your request for *free samples* — leading surely to **SOLIDARITY** in your machine assemblies.

Your local Allen Distributor will oblige with samples and SERVICE.

THE ALLEN MANUFACTURING COMPANY
HARTFORD, CONN., U. S. A.

GAMMONS
OF
Manchester



PRODUCTION TOOLS

ORIGINATORS AND
MANUFACTURERS OF HELICAL
FLUTED TAPER PIN REAMERS

THE GAMMONS-HOLMAN CO., MANCHESTER, CONNECTICUT

MADISON BORING BARS



**No Scoring!
No Overheating!**

MADISON
Manufacturing Co.
Muskegon, Mich.

Production and accuracy go up when scoring and overheating are eliminated. The Madison floating cutter compensates for misalignment and Madison design insures freedom from distortion due to overheating.

Use them for all work from $\frac{1}{8}$ " up and get accuracy to .00025".

MORGAN

Efficient handling of heavy parts eliminates costly production delays. Call on Morgan for the solution to your shop transportation problems.

MORGAN ENGINEERING CO. Alliance, O.

CRANES



Duplicates of the Johansson Blocks used most often in your shop might save a lot of time. Minutes lost by your men waiting to use a gage block mount into hours by the end of a week. The hours are worth dollars and for only a few dollars you could furnish individual duplicate blocks to cut down wasted shop time.

Individual Johansson Gage Blocks cost as little as \$3.50. Sets range from \$23 with case. Most Johansson Blocks are available chrome-plated.

Johansson Catalog will give you prices of the duplicate blocks you need. Mail coupon below.

FORD MOTOR COMPANY

Johansson Division Dept. F Dearborn, Michigan

Please send me free copy of Catalog No. 15.

Name _____

Address _____

City _____ State _____



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HARDNESS TESTER**

This new inexpensive pocket-size Hardness Tester, known as the Tool-makers Model "E", retains all the fine features found in our larger production Model "D" Scleroscope. The operation is as simple as an automatic center punch, applied as readily as a surface gauge, and as dependable as a micrometer.

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Strictly Modern Equipment, Backed by the Skill and Judgment of 30 Years Experience. Also, We Sell "Heat-Easy" Compound for Pack Hardening High Speed and High Carbon—High Chrome Steels.

THE BENNETT METAL TREATING COMPANY, Elmwood, Conn.



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DOUBLE SCALE
UNIVERSAL
INDICATOR**

Price, Complete with Holder, \$4.00
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335 Sagamore Drive, Rochester, N. Y.

FOSTER BARKER
Wrenchless
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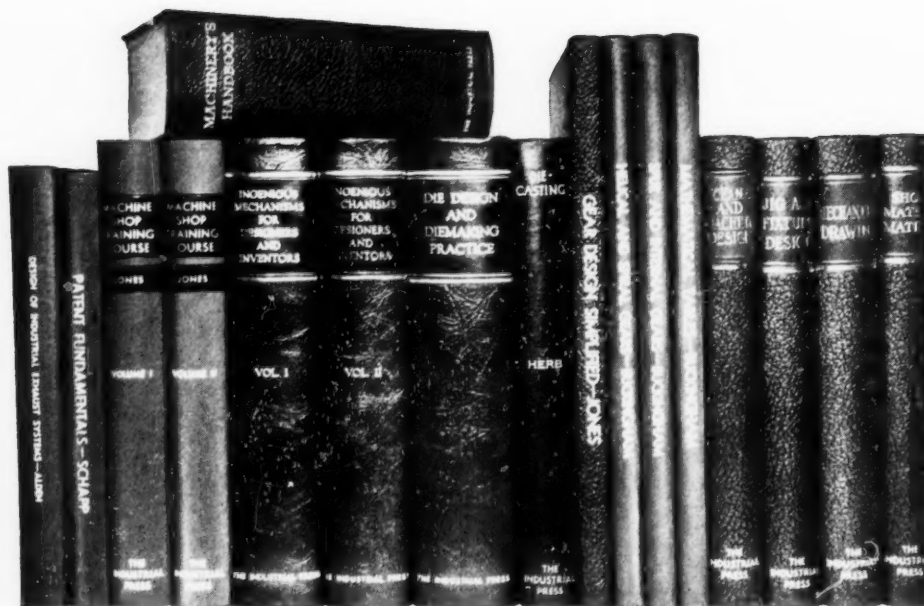
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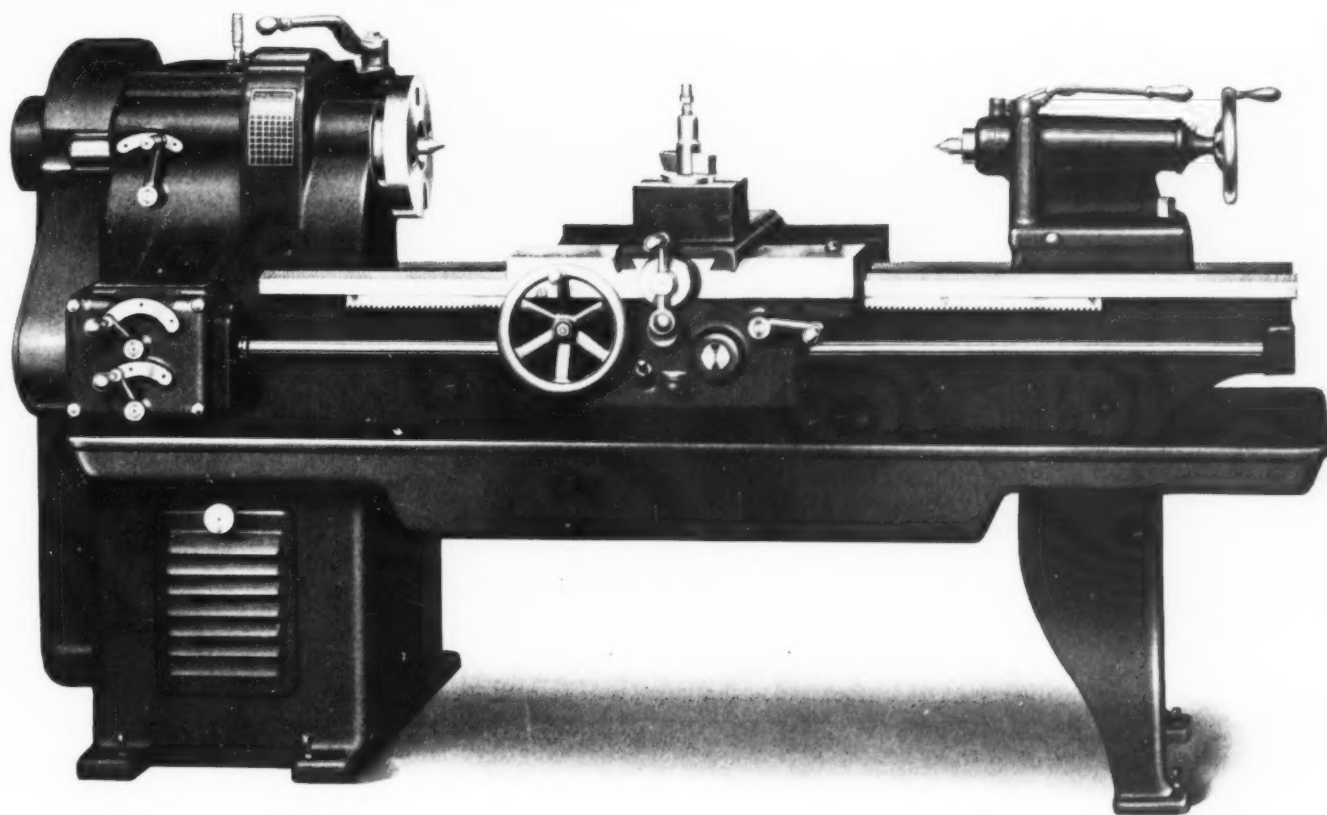
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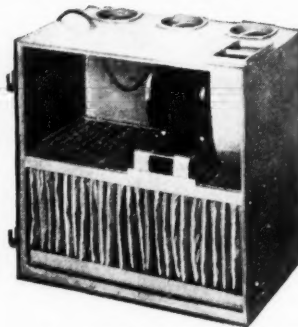
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Lake Erie Engineering Corp., Buffalo, N. Y.
Morgan Engineering Co., Alliance, O.
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See Hoists, Air.

AIR TOOLS

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Pneumatic, etc.

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See Boring Bars.

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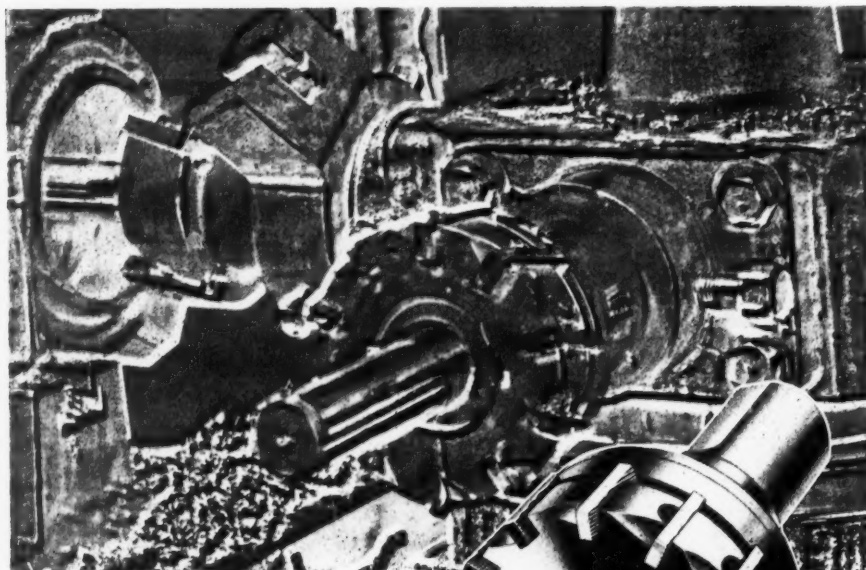
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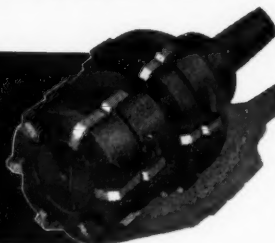


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National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.



Service Die & Engineering Company, Detroit, made this complete die on the DoAll. It

is used to make the glove compartment on the instrument panel of a well-known automobile.

DIE—2¼" thick mild steel was sawed cut in 1¾ hours.

PAD—1½" thick air die steel, sawed out in 2½ hours.
25 pounds of steel were saved.

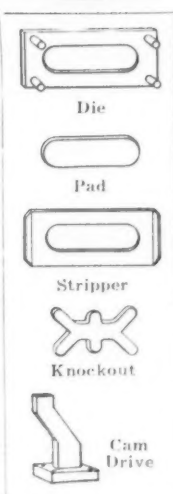
STRIPPER—¾" cold roll, sawed out in 45 minutes.

KNOCKOUT—¾" cold roll, sawed out in 30 minutes.

CAM DRIVES (on the DoAll table)—2½" oil hardened tool steel, sawed out in 20 minutes each. Later they were welded to base.

Two DoAll Contour Machines and one DoAll Band Filer are kept busy 24 hours a day in this modern plant.

The DoAll is a moderately priced, rugged machine tool that replaces shaping, milling and lathe work with enormous savings of time, labor and metal.



Send for Free 158-page
Metal Working Handbook.

CONTINENTAL MACHINES, Inc.
1312 S. WASHINGTON AVE.,
MINNEAPOLIS, MINN.

- ☐ Send data on the DoAll
☐ Send Free Handbook

Name

Address

DRILLS, WIRE

Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Union Twist Drill Co., Athol, Mass.

DRIVES, MOTORIZED BELT

Cullman Wheel Co., 1339 Altgeld St., Chicago.

DUST CONTROL SYSTEMS

American Fdry. Equipment Co., Mishawaka, Ind.
Pangborn Corp., Hagerstown, Md.

ELECTRICAL EQUIPMENT

Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

ELEVATORS, MATERIAL HANDLING

Stephens-Adamsen Mfg. Co., Aurora, Ill.

EMERY WHEELS

See Grinding Wheels.

EMERY WHEEL DRESSERS

See Dressers, Grinding Wheel.

ENGRAVING MACHINES

Gorton Machine Co., Racine, Wis.
United States Electrical Tool Co., Cincinnati.

EXTRACTORS, SCREW

Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

FACING MACHINE

Ex-Cell-O Corp., Detroit.

FANS, EXHAUST, ELECTRIC VENTILATING

General Electric Co., Schenectady, N. Y.
Wagner Electric Co., St. Louis, Mo.

FEEDS FOR PUNCH PRESSES, AUTOMATIC

Cleveland Punch & Shear Works Co., Cleveland, O.
Littell, F. J., Mch. Co., 4125 Ravenswood Ave., Chicago.

S. & S. Machine Wks., 4541 W. Lake St., Chicago.

U. S. Tool Company, Inc., Ampere, N. J.

V & O Press Co., Hudson, N. Y.

FILES

American Swiss File & Tool Co., Elizabeth, N. J.
Nicholson File Co., Providence.

FILES, MACHINE

Oliver Instrument Co., Adrian, Mich.

FILES, ROTARY

Pratt & Whitney Co., Hartford, Conn.
Stow Mfg. Co., Binghamton, N. Y.
Strand, N. A., & Co., 5901 N. Wolcott Ave., Chicago.

United States Electrical Tool Co., Cincinnati.

FILING MACHINES, DIE, ETC.

Ames, B. C. Co., Waltham, Mass.
Continental Machines, Inc., Minneapolis, Minn.
Grob Bros., West Allis, Wis.
Illinois Tool Wks., 2501 N. Keeler Ave., Chicago
Oliver Instrument Co., Adrian, Mich.
Stow Mfg. Co., Binghamton, N. Y.

FILTERS, COOLANT AND OIL

Cuno Engineering Corp., Meriden, Conn.

FITTINGS, HYDRAULIC

Hydraulic Press Mfg. Co., Mt. Gilead, O.
Watson-Stillman Co., Roselle, N. J.

FLEXIBLE COUPLINGS

See Couplings, Flexible.

FLEXIBLE SHAFT EQUIPMENT

Dumore Co., Racine, Wis.
Haskins, R. G. Co., 617 So. California Ave., Chicago.

Pratt & Whitney Co., Hartford, Conn.

Stow Mfg. Co., Binghamton, N. Y.

Strand, N. A., & Co., 5901 N. Wolcott Ave., Chicago.

United States Electrical Tool Co., Cincinnati.

FORGING (UPSETTING) MACHINES

Hill Acme Co., Cleveland.

FORGINGS, DROP

Bethlehem Steel Co., Bethlehem, Pa.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

FORGINGS, HOLLOW BORED

American Hollow Boring Co., Erie, Pa.
Bethlehem Steel Co., Bethlehem, Pa.

FORGINGS, IRON AND STEEL

Bethlehem Steel Co., Bethlehem, Pa.
Morgan Engineering Co., Alliance, O.

FORGINGS, UPSET

Bethlehem Steel Co., Bethlehem, Pa.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

FORMING AND BENDING MACHINES

Cleveland Punch & Shear Works Co., Cleveland, O.
Baldwin-Southwark Corp., Philadelphia, Pa.

Bethlehem Steel Co., Bethlehem, Pa.

Cincinnati Shaper Co., Cincinnati.

Consolidated Mch. Tool Corp., Rochester, N. Y.

Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.

Hydraulic Press Mfg. Co., Mount Gilead, O.

FORMING AND STAMPING MACHINES

Cincinnati Shaper Co., Cincinnati.
U. S. Tool Company, Inc., Ampere, N. J.

FORMING TOOLS OR TOOL BLANKS

Brown & Sharpe Mfg. Co., Providence.
National Broach & Mch. Co., Detroit.

Pratt & Whitney Co., Hartford, Conn.

FRAMES, MACHINERY, WELDED

Mahon, R. C. Co., Detroit, Mich.

FURNACES, HARDNESS

Leeds & Northrup Co., Philadelphia.

FURNACES, HEAT-TREATING ELECTRIC

Electric Furnace Co., Salem, O.
General Electric Co., Schenectady, N. Y.

Leeds & Northrup Co., Philadelphia.

Stark Tool Co., Waltham, Mass.

Strong, Carlisle, & Hammond Co., Cleveland.

FURNACES, HEAT-TREATING OIL, GAS, ETC.

Electric Furnace Co., Salem, O.
Strong, Carlisle, & Hammond Co., Cleveland.

FURNITURE, SHOP

Standard Pressed Steel Co., Jenkintown, Pa.

GAGE BLOCKS

Johansson Div. Ford Motor Co., Dearborn, Mich.
Pratt & Whitney Co., Hartford, Conn.

GAGES, COMPARATOR

Federal Products Corp., Providence, R. I.
Jones & Lamson Machine Co., Springfield, Vt.

Pratt & Whitney Co., Hartford, Conn.

GAGES, DEPTH

Brown & Sharpe Mfg. Co., Providence.
Federal Products Corp., Providence, R. I.

Starrett, L. S. Co., Athol, Mass.

GAGES, DIAL

Ames, B. C. Co., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence.

Federal Products Corp., Providence, R. I.

Starrett, L. S. Co., Athol, Mass.

GAGES, ELECTRIC

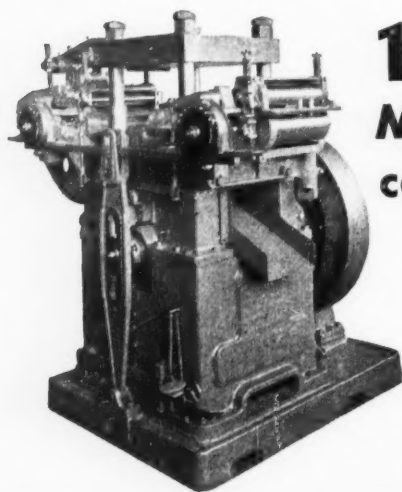
Pratt & Whitney Co., Hartford, Conn.

GAGES, HEIGHT

Brown & Sharpe Mfg. Co., Providence.
Starrett, L. S. Co., Athol, Mass.

GAGES, PLUG, RING AND SNAP

Brown & Sharpe Mfg. Co., Providence.
Carboloy Co., Inc., Detroit.



1 MODERN Dieing Machine replaces 5 to 10 conventional presses!

—Saving 60% to 90% of stamping cost

—Increasing die life 600% to 1200%

HENRY & WRIGHT DIEING MACHINES

Producing **COMPLETED** stampings at every stroke



INDUSTRIAL

Stampings made complete on the Dieing Machine include many formerly machined at much greater cost. Above part is .156" hot rolled steel, produced 7600 per hour.



AIRPLANE

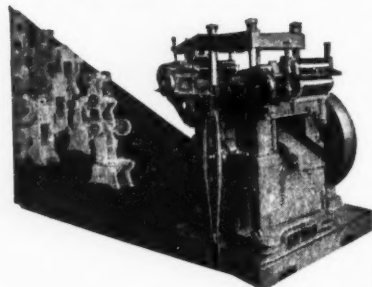
Dieing Machines are extensively used for producing numerous precision parts for airplane use. Above is strut seat of .031" brass produced complete each stroke; 140 strokes per minute in 50-ton Dieing Machine.



MUNITIONS

Producing parts to precision of .0002", Dieing Machines are widely used to make machine gun belt links, bomb parts, mechanical time fuse components, etc. Above is cartridge clip for .303 bolt operated rifle produced complete 100 per min.

1 Dieing Machine replaces 5 to 10 conventional presses.



Dieing Machines offer a unique combination of high speed operation and smoothness, increasing die life 600% to 1200% and permitting precision of product to .0002". They produce 1 to 20 completed parts per stroke at speeds up to 600 s.p.m. Use this MODERN stamping method to cut costs 60% to 90%!

CATALOG 40 SENT FREE

THE HENRY & WRIGHT MFG. CO.
HARTFORD, CONN.

Dieing Machines—Steel Presses—Roll Straighteners—
Stock Reels—Sensitive Drilling Machines

BLANKING—PIERCING—DRAWING—FORMING—COINING—EXTRUDING

Ex-Cell-O Corporation, Detroit.
Federal Products Corp., Providence, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Haynes Stellite Co., Kokomo, Ind.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Starrett, L. S. Co., Athol, Mass.

GAGES, RECORDING, STEAM VACUUM
Bristol Company, Waterbury, Ct.

GAGES, SURFACE
Brown & Sharpe Mfg. Co., Providence.
Columbus Die, Tool & Mch. Co., Columbus, O.
Starrett, L. S. Co., Athol, Mass.

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Johansson Div. Ford Motor Co., Dearborn, Mich.
Pratt & Whitney Co., Hartford, Conn.
Starrett, L. S. Co., Athol, Mass.

GAGES, THREAD
Bath, John, & Co., Inc., Worcester, Mass.
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Federal Products Corp., Providence, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Machine Co., Hartford, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
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Garlock Packing Co., Palmyra, N. Y.
Manhattan Rubber Mfg. Div. Raybestos-Manhattan, Inc., Passaic, N. J.

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Ganschow Gear Co., 16 N. Morgan St., Chicago.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

GEAR BURNISHING MACHINES
Fellows Gear Shaper Co., Springfield, Vt.

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Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Illinois Tool Wks., 2501 N. Keeler Ave., Chicago.
National Broach & Mch. Co., Detroit.
Pratt & Whitney Co., Hartford, Conn.

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Bilgram Gear & Machine Wks., Philadelphia.
Gleason Works, Rochester, N. Y.

GEAR CUTTING MACHINES, BEVEL AND SPUR (ROTARY CUTTER)
Waltham Mch. Wks., Waltham, Mass.

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Barber-Colman Co., Rockford, Ill.
Lees-Bradner Co., Cleveland.
New Jersey Gear & Mfg. Co., Newark, N. J.

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Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.
Fellows Gear Shaper Co., Springfield, Vt.

GEAR CUTTING MACHINES, SPIRAL BEVEL
Gleason Works, Rochester, N. Y.

GEAR CUTTING MACHINES, WORM AND WORM WHEELS
Barber-Colman Co., Rockford, Ill.
Fellows Gear Shaper Co., Springfield, Vt.
(Straight & Hourglass Type).
Lees-Bradner Co., Cleveland.
New Jersey Gear & Mfg. Co., Newark, N. J.

GEAR FINISHING MACHINES
Fellows Gear Shaper Co., Springfield, Vt.

GEAR GRINDING MACHINES (BEVEL)
Gleason Works, Rochester, N. Y.
Pratt & Whitney Co., Hartford, Conn.

GEAR HARDENING MACHINES
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.

GEAR LAPPING MACHINES
Fellows Gear Shaper Co., Springfield, Vt.
National Broach & Mch. Co., Detroit.

GEAR LAPPING MACHINES (BEVEL)
Gleason Works, Rochester, N. Y.

GEAR MOTORS
See Speed Reducers.

GEAR SHAVING MACHINES
Fellows Gear Shaper Co., Springfield, Vt.
National Broach & Mch. Co., Detroit.

GEAR TESTING MACHINERY
Brown & Sharpe Mfg. Co., Providence.
Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Lees-Bradner Co., Cleveland.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

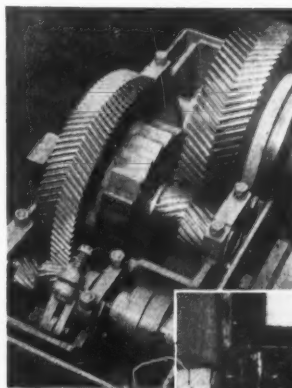
GEAR TOOTH GRINDING MACHINES
Lees-Bradner Co., Cleveland.
Pratt & Whitney Co., Hartford, Conn.

GEARS, OUT
Atlantic Gear Works, Inc., 124 Lafayette St., New York.
Bethlehem Steel Co., Bethlehem, Pa.
Bilgram Gear & Machine Works, Philadelphia.
Boston Gear Works, Inc., No. Quincy, Mass.
Braun Gear Corp., Brooklyn, N. Y.

Brown & Sharpe Mfg. Co., Providence.
Cleveland Worm & Gear Co., Cleveland.
Crofoot, Chas. E., Gear Corp., So. Easton, Mass.
Diefendorf Gear Corp., Syracuse, N. Y.
Earle Gear & Mch. Co., Philadelphia.
Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow Gear Co., 16 N. Morgan St., Chicago.
General Electric Co., Pittsfield, Mass.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Inc., Boston, Mass.
Hartford Special Mch. Co., Hartford, Conn.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
Lees-Bradner Co., Cleveland.
Massachusetts Gear & Tool Co., Woburn, Mass.
Meisel Press Mfg. Co., Boston, Mass.
National-Erie Corp., Erie, Pa.
New Jersey Gear & Mfg. Co., Newark, N. J.
Perkins Mch. & Gear Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia.
Pittsburgh Gear & Machine Co., Pittsburgh.
Stahl Gear & Machine Co., Cleveland.
Taylor Mch. Co., Cleveland.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

GEARS, MOLDED
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
National-Erie Corp., Erie, Pa.
Philadelphia Gear Wks., Philadelphia.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

GEARS, RAWHIDE AND NON-METALLIC
Atlantic Gear Works, Inc., 124 Lafayette St., New York.
Boston Gear Works, Inc., No. Quincy, Mass.
Braun Gear Corp., Brooklyn, N. Y.
Crofoot, Chas. E., Gear Corp., So. Easton, Mass.
Diefendorf Gear Corp., Syracuse, N. Y.
Earle Gear & Mch. Co., Philadelphia.
Ganschow Gear Co., 16 N. Morgan St., Chicago.
General Electric Co., Pittsfield, Mass.
Grant Gear Works, Inc., Boston, Mass.
Hartford Special Mch. Co., Hartford, Conn.
Massachusetts Gear & Tool Co., Woburn, Mass.
Meisel Press Mfg. Co., Boston, Mass.
Philadelphia Gear Works, Philadelphia.
Pittsburgh Gear & Machine Co., Pittsburgh.
Stahl Gear & Machine Co., Cleveland.
Taylor Mch. Co., Cleveland.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.



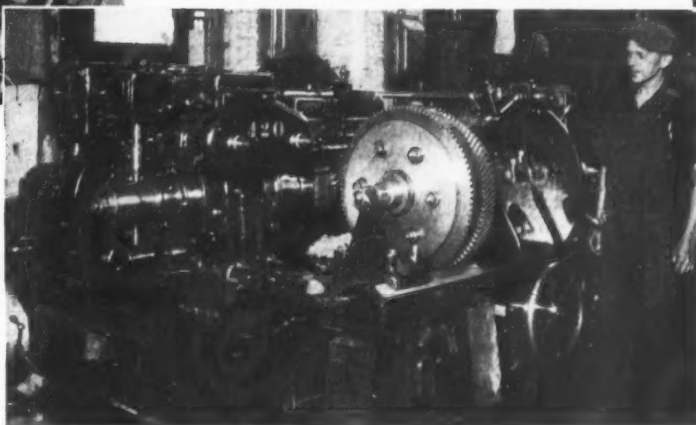
Hoist unit for a Whiting crane with Sykes Continuous-Tooth Herringbone Gears.

This Farrel-Sykes Gear Generator has turned out precision gears for the Whiting Corporation for over 12 years.

After 12 Years Constant Service

FARREL-SYKES Gear Generator

STILL CUTS GEARS WITH
SPEED and PRECISION



FOR over a dozen years the Farrel-Sykes Gear Generator illustrated here has been cutting high-precision continuous-tooth herringbone gears for use in the cranes manufactured by the Whiting Corporation—rapidly and economically.

"It is still doing a fine job," says this manufacturer, who emphasizes the accuracy and smooth, quiet dependability of the gears this machine generates.

This long record of trouble-free performance is typical of Farrel-Sykes Gear Generators. They retain their exceptional accuracy for many thousands of hours, for they are fully equipped with means of compensating for wear, and wherever wear is apt to affect their pre-

cision, hardened, ground and lapped surfaces are used.

Farrel-Sykes Gear Generators are unusually versatile. They will generate with equal facility and accuracy every type of gear used for connecting parallel axes. Their diversified output includes, in addition to continuous-tooth herringbone gears, single helical and straight tooth gears with both external and internal teeth, any known type of double helical gear, two members of a cluster gear (cut simultaneously) and many other toothed forms and special contours.

These machines are built in six standard sizes and will generate gears from the smallest practicable minimum to 264" diameter, with face widths up to 60" and pitches from 24 DP to 0.5 DP.

We shall be glad to send descriptive literature and specifications upon request.



FARREL-BIRMINGHAM COMPANY, Inc.

377 VULCAN ST.

BUFFALO, N. Y.

The Gear with a Backbone

GENERATORS, ELECTRIC

General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

GRADUATING MACHINES

Gorton Machine Co., Racine, Wis.

GREASE

Lubri-Zol Corp., Cleveland, O.
Standard Oil Co. (Indiana) Chicago, Ill.
Sun Oil Co., Philadelphia.
Texas Co., 135 E. 42nd St., New York.

GRINDERS, CARBIDE TOOL

Baldor Electric Co., St. Louis, Mo.
Oliver Instrument Co., Adrian, Mich.
Sundstrand Mch. Tool Co., Rockford, Ill.

GRINDERS, DIE AND MOLD

Consolidated Mch. Tool Corp., Rochester, N. Y.
Dumore Co., Racine, Wis.
Haskins, R. G., Co., 617 S. California Ave., Chicago.
Pratt & Whitney Co., Hartford, Conn.
Stow Mfg. Co., Binghamton, N. Y.
United States Electrical Tool Co., Cincinnati.

GRINDERS FOR SHARPENING TURNING AND PLANING TOOLS

Delta Mfg. Co., Milwaukee, Wis.
Gisholt Machine Co., Madison, Wis. (Machine Ground).
Oliver Instrument Co., Adrian, Mich.
Sellers, Wm., & Co., Inc., Philadelphia.

(Machine Ground)
Sundstrand Mch. Tool Co., Rockford, Ill.
Van Dorn Electric Tools, Towson, Md.
Walker, O. S., Co., Inc., Worcester, Mass.
Waltham Mch. Wks., Waltham, Mass.

GRINDERS, OILSTONE, FOR WOODWORKING TOOLS

Mummert-Dixon Co., Hanover, Pa.

GRINDERS, PNEUMATIC

Ingersoll-Rand Co., 11 Broadway, New York.
Madison-Kipp Corp., Madison, Wis.
Onsrud Machine Works, Inc., 3940 Palmer St., Chicago, Ill.

GRINDERS, PORTABLE ELECTRIC AND TOOLPOST

Black & Decker Mfg. Co., Towson, Md.

Dumore Co., Racine, Wis.
Haskins, R. G., Co., 617 S. California Ave., Chicago.

United States Electrical Tool Co., Cincinnati.
Van Dorn Electric Tools, Towson, Md.

GRINDING MACHINES, ABRASIVE BELT

Continental Machines, Inc., Minneapolis, Minn.
Delta Mfg. Co., Milwaukee, Wis.
Mattison Mch. Wks., Rockford, Ill.
Walls Sales Corp., 96 Warren St., New York.

GRINDING MACHINES, BENCH

Black & Decker Mfg. Co., Towson, Md.
Delta Mfg. Co., Milwaukee, Wis.
Hardinge Brothers, Inc., Elmira, N. Y.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

United States Electrical Tool Co., Cincinnati.
Van Dorn Electric Tools, Towson, Md.

GRINDING MACHINES, CAMSHAFT

Landis Tool Co., Waynesboro, Pa.
Norton Co., Worcester, Mass.

GRINDING MACHINES, CEMENTED CARBIDE TOOL

Carboly Co., Inc., Detroit.
Ex-Cel-O Corporation, Detroit.
Oliver Instrument Co., Adrian, Mich.

GRINDING MACHINES, CENTERLESS

Cincinnati Grinders Inc., Cincinnati.

GRINDING MACHINES, CHASER, OR DIE

Eastern Mch. Screw Corp., New Haven, Conn.
Landis Mch. Co., Waynesboro, Pa.

GRINDING MACHINES, CHUCKING

Bryant Chucking Grinder Co., Springfield, Vt.

GRINDING MACHINES, CRANKSHAFT

Landis Tool Co., Waynesboro, Pa.
Norton Co., Worcester, Mass.

GRINDING MACHINES, CYLINDER

Bryant Chucking Grinder Co., Springfield, Vt.
Heald Machine Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.

GRINDING MACHINES, CYLINDRICAL

Arter Grinding Mch. Co., Providence.
Brown & Sharpe Mfg. Co., Providence.
Cincinnati Grinders Inc., Cincinnati.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Wks. (Cons. Mch. Tool Corp.), Rochester, N. Y.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Norton Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.

Thompson Grinder Co., Springfield, O.
United States Electrical Tool Co., Cincinnati.

GRINDING MACHINES, DISC

Bealy, Chas. H., & Co., 120-B N. Clinton St., Chicago.

Gardner Machine Co., Beloit, Wis.
Hanchett Mfg. Co., Big Rapids, Mich.
Production Mch. Co., Greenfield, Mass.
United States Electrical Tool Co., Cincinnati.

GRINDING MACHINES, DRILL

Delta Mfg. Co., Milwaukee, Wis.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Oliver Instrument Co., Adrian, Mich.
Sellers, Wm., & Co., Inc., Philadelphia.
Union Twist Drill Co., Athol, Mass.

GRINDING MACHINES, FACE

Abrasive Mch. Tool Co., E. Providence, R. I.
Hanchett Mfg. Co., Big Rapids, Mich.
Oliver Instrument Co., Adrian, Mich.

GRINDING MACHINES, FLEXIBLE SHAFT

See Flexible Shaft Equipment.

GRINDING MACHINES, INTERNAL

Bryant Chucking Grinder Co., Springfield, Vt.
Heald Machine Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Wks. (Cons. Mch. Tool Corp.), Rochester, N. Y.

Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.

GRINDING MACHINES, KNIFE AND SHEAR BLADE

Hanchett Mfg. Co., Big Rapids, Mich.

GRINDING MACHINES, PISTON RING

Arter Grinding Mch. Co., Worcester, Mass.
Heald Machine Co., Worcester, Mass.

GRINDING MACHINES, PULLEY

Abrasive Mch. Tool Co., East Providence, R. I.

GRINDING MACHINES, RADIAL, BALL RACE, ETC.

Landis Tool Co., Waynesboro, Pa.

GRINDING MACHINES, RADIUS, LINK

Consolidated Mch. Tool Corp., Rochester, N. Y.
Sundstrand Mch. Tool Co., Rockford, Ill.

GRINDING MACHINES, RING WHEEL

Bealy, Chas. H., & Co., 120-B N. Clinton St., Chicago.

Gardner Machine Co., Beloit, Wis.

GRINDING MACHINES, ROLL

Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.

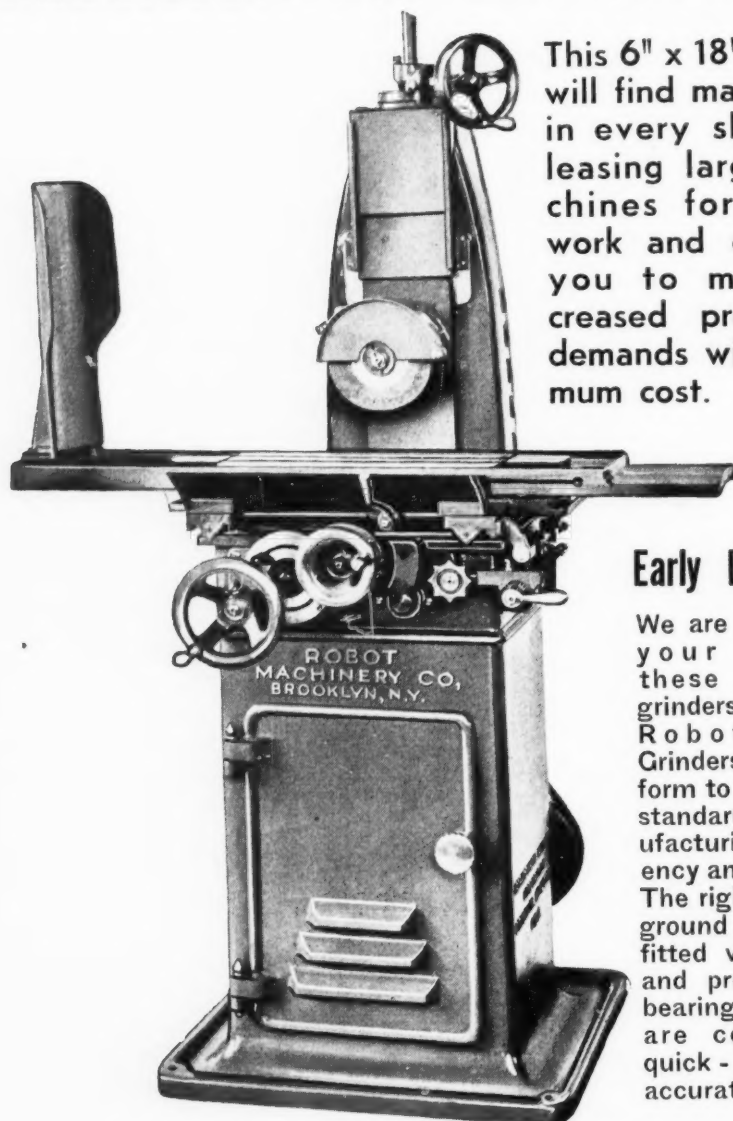
Landis Tool Co., Waynesboro, Pa.
Norton Co., Worcester, Mass.

GRINDING MACHINES, SURFACE

Abrasive Mch. Tool Co., East Providence, R. I.
Arter Grinding Mch. Co., Worcester, Mass.

-ROBOT-

PRECISION SURFACE GRINDER



This 6" x 18" grinder will find many uses in every shop, releasing larger machines for larger work and enabling you to meet increased production demands with minimum cost.

Early Deliveries!

We are able to fill your orders for these precision grinders promptly. Robot Surface Grinders will perform to the highest standards of manufacturing efficiency and accuracy. The rigid spindle is ground and lapped, fitted with bronze and precision ball bearings. Controls are convenient, quick-acting and accurate.

ROBOT MACHINERY COMPANY

326 Ten Eyck St. BROOKLYN, N. Y.

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Brown & Sharpe Mfg. Co., Providence.
Continental Machines, Inc., Minneapolis, Minn.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Gardner Mch. Co., Beloit, Wis.
Hanchett Mfg. Co., Big Rapids, Mich.
Heald Machine Co., Worcester, Mass.
Hill Acme Co., Cleveland.
Mattison Machine Works, Rockford, Ill.
Norton Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Robot Machinery Co., 326 Ten Eyck St., Brooklyn, N. Y.

Thompson Grinder Co., Springfield, O.
United States Electrical Tool Co., Cincinnati.
Walker, O. S., Co., Inc., Worcester, Mass.

GRINDING MACHINES, SWING FRAME

Manhattan Rubber Mfg. Div. Raybestos-Manhattan, Inc., Passaic, N. J.
United States Electrical Tool Co., Cincinnati.

GRINDING MACHINES, TAP

Ex-Cell-O Corp., Detroit.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Oliver Instrument Co., Adrian, Mich.

GRINDING MACHINES, THREAD

Ex-Cell-O Corporation, Detroit.
Jones & Lamson Mch. Co., Springfield, Vt.

GRINDING MACHINES, UNIVERSAL, FOR SHARPENING CUTTERS, REAMERS, HOBS, ETC.

Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence.
Cincinnati Milling Mch. Co., Oakley, Cincinnati.
Continental Machines, Inc., Minneapolis, Minn.
Fellows Gear Shaper Co., Springfield, Vt. (Helical Gear Shaper Cutters)
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Ingersoll Milling Mch. Co., Rockford, Ill.
Landis Tool Co., Waynesboro, Pa.
Le Blond, R. K., Mch. Tool Co., Cincinnati.
Norton Co., Worcester, Mass.
Oliver Instrument Co., Adrian, Mich.
Pratt & Whitney Co., Hartford, Conn.
Thompson Grinder Co., Springfield, O.
Union Twist Drill Co., Athol, Mass.

GRINDING MACHINES, WORM

Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

GRINDING WHEELS

Bakelite Corp., 30 East 42nd St., New York.
Blanchard Mch. Co., Cambridge, Mass.
Carborundum Co., Niagara Falls, N. Y.
Manhattan Rubber Mfg. Div. Raybestos-Manhattan, Inc., Passaic, N. J.
Norton Co., Worcester, Mass.

GUARDS FOR PUNCH PRESSES, SAFETY

Taylor-Shantz, Inc., Rochester, N. Y.

HAMMERS, DROP

Chambersburg Engineering Co., Chambersburg, Pa.
Morgan Engineering Co., Alliance, O.

HAMMERS, PNEUMATIC

Madison-Kipp Corp., Madison, Wis.

HAMMERS, PORTABLE ELECTRIC

Black & Decker Mfg. Co., Towson, Md.
Van Dorn Electric Tools, Towson, Md.

HAMMERS, SOFT

Greene, Tweed & Co., 101 Park Ave., New York.

HAMMERS, STEAM

Chambersburg Engineering Co., Chambersburg, Pa.
Sellers, Wm., & Co., Inc., Philadelphia.

HANGERS, SHAFT

Boston Gear Works, Inc., No. Quincy, Mass.
Hyatt Bearings Div. General Motors Sales Corp., Harrison, N. J.

Sellers, Wm., & Co., Inc., Philadelphia.

Shaffer Bearing Corp., 35 E. Wacker Drive, Chicago.

S. K. F. Industries, Inc., Philadelphia.
Standard Pressed Steel Co., Jenkintown, Pa.

HARDENING EQUIPMENT, INDUCTION

Ohio Crankshaft Co., Cleveland.

HARDNESS TESTING INSTRUMENTS

Shore Instrument & Mfg. Co., Jamaica, N. Y.
Wilson Mechanical Instrument Co., Inc., 382 Concord Ave., New York.

HEAT TREATMENT OF STEEL

Bennett Metal Treating Co., Elmwood, Conn.
Davis Boring Tool Div., St. Louis, Mo.
National-Erie Corp., Erie, Pa.
Pittsburgh Gear & Mch. Co., Pittsburgh.

HOBGING MACHINES

See Gear Cutting Machines, Helical and Spur (Hob); and Gear Cutting Machines, Worm and Worm Wheels.

HOBS

Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence.
Illinois Tool Wks., 2501 N. Keeler Ave., Chicago.
Lees-Bradner Co., Cleveland.
National Twist Drill & Tool Co., Detroit.
New Jersey Gear & Mfg. Co., Newark, N. J.
Union Twist Drill Co., Athol, Mass.

HOIST HOOKS

Bethlehem Steel Co., Bethlehem, Pa.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

HOISTING AND CONVEYING MACHINERY

Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

HOISTS, AIR

Ingersoll-Rand Co., 11 Broadway, New York.
Norton Engrg. Wks., Detroit.

HOISTS, CHAIN, ETC.

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

HOISTS, ELECTRIC

Philadelphia Gear Works, Philadelphia.
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

HOISTS, HYDRAULIC

Hydraulic Press Mfg. Co., Mt. Gilead, O.

HONES

Carborundum Co., Niagara Falls, N. Y.
Moline Tool Co., Moline, Ill.

HONING MACHINES, CYLINDER

Barnes, W. F., & John, Co., Rockford, Ill.
Barnes Drill Co., Rockford, Ill.

HONING MACHINES, EXTERNAL

Barnes Drill Co., Rockford, Ill.
Foster Mch. Co., Elkhart, Ind.

HOSE, LEATHER, RUBBER, METALLIC, ETC.

Manhattan Rubber Mfg. Div. Raybestos-Manhattan, Inc., Passaic, N. J.

HYDRAULIC MACHINERY, TOOLS AND EQUIPMENT

Baldwin-Southwark Corp., Philadelphia, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Lake Erie Engineering Corp., Buffalo, N. Y.
National-Erie Corp., Erie, Pa.
Sundstrand Mch. Tool Co., Rockford, Ill.
Watson-Stillman Co., Roselle, N. J.

HYDRAULIC POWER UNITS

Barnes, W. F., & John, Co., Rockford, Ill.

HYDRAULIC TOOL HEADS OR POWER UNITS

Ex-Cell-O Corporation, Detroit.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.

INDEX CENTERS

Abrasive Mch. Tool Co., East Providence, R. I.
Brown & Sharpe Mfg. Co., Providence.

INDEXING AND SPACING FIXTURES

Hartford Special Mchry. Co., Hartford, Conn.

INDICATORS, DIAL

Ames, B. C., Co., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence.
Federal Products Corp., Providence, R. I.
Starrett, L. S., Co., Athol, Mass.

INDICATORS, SPEED

Bristol Company, Waterbury, Ct.
Brown & Sharpe Mfg. Co., Providence.
Starrett, L. S., Co., Athol, Mass.
Veeder-Root, Inc., Hartford, Conn.

INDICATORS, TEST

Brown & Sharpe Mfg. Co., Providence.
Federal Products Corp., Providence, R. I.
Ideal Tool Co., Rochester, N. Y.
Starrett, L. S., Co., Athol, Mass.

INTENSIFIERS, HYDRAULIC

Baldwin-Southwark Corp., Philadelphia, Pa.
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Morgan Engineering Co., Alliance, O.
Watson-Stillman Co., Roselle, N. J.

JACKS, PLANNER

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.

JIG BORER

See Boring Machines, Jig.

JIGS AND FIXTURES

Columbus Die, Tool & Mch. Co., Columbus, O.
Ex-Cell-O Corporation, Detroit.
Hartford Special Mchry. Co., Hartford, Conn.
Ingersoll Milling Mch. Co., Rockford, Ill.
Modern Mch. Corp., Brooklyn, N. Y.
Sundstrand Mch. Tool Co., Rockford, Ill.

KEYS, WOODRUFF TYPE

Whitney Chain & Mfg. Co., Hartford, Conn.

KEYSEATERS

Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis Keyseater Co., Rochester, N. Y.

KNURL HOLDERS

Graham Mfg. Co., Providence.
Pratt & Whitney Co., Hartford, Conn.

KNURLING TOOLS

American Swiss File & Tool Co., Elizabeth, N. J.
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Graham Mfg. Co., Providence.

Pratt & Whitney Co., Hartford, Conn.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

LAPPING MACHINES

Cincinnati Grinders, Inc., Cincinnati.
Ex-Cell-O Corp., Detroit.
Norton Co., Worcester, Mass.

LATHE ATTACHMENTS

American Tool Wks. Co., Cincinnati.
Cincinnati Lathe & Tool Co., Oakley, Cincinnati.
Gisholt Mch. Co., Madison, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond, R. K., Mch. Tool Co., Cincinnati.
Lodge & Shipley Mch. Tool Co., Cincinnati.
McCroskey Tool Corp., Meadville, Pa.
Monarch Mch. Tool Co., Sidney, O.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
South Bend Lathe Wks., Inc., South Bend, Ind.
Springfield Mch. Tool Co., Springfield, O.
Stark Tool Co., Waltham, Mass.

Sundstrand Mch. Tool Co., Rockford, Ill.
United States Electrical Tool Co., Cincinnati.
Warner & Swasey Co., Cleveland.

LATHE DOGS

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Ready Tool Co., Bridgeport, Conn.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

LATHES, AUTOMATIC

Baird Mch. Co., Bridgeport, Conn.
Gisholt Mch. Co., Madison, Wis.
Goss & DeLeeuw Mch. Co., New Britain, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond, R. K., Mch. Tool Co., Cincinnati.
Lodge & Shipley Mch. Tool Co., Cincinnati.
Monarch Mch. Tool Co., Sidney, O.
National Acme Co., Cleveland.
Potter & Johnston Mch. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., Rockford, Ill.

LATHES, AXLES AND SHAFT

Consolidated Mch. Tool Corp., Rochester, N. Y.
Lodge & Shipley Mch. Tool Co., Cincinnati.
Sellers, Wm., & Co., Inc., Philadelphia.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., Rockford, Ill.

LATHES, BENCH

Ames, B. C., Co., Waltham, Mass.
Elgin Tool Wks., Inc., Bertau & Ravenswood Ave., Chicago.
Hardinge Brothers, Inc., Elmira, N. Y.
Le Blond, R. K., Mch. Tool Co., Cincinnati.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
South Bend Lathe Wks., Inc., South Bend, Ind.
Stark Tool Co., Waltham, Mass.

LATHES, BORING

Gisholt Mch. Co., Madison, Wis.
Le Blond, R. K., Mch. Tool Co., Cincinnati.
Lodge & Shipley Mch. Tool Co., Cincinnati.

LATHES, BRASS WORKERS'

Acme Machine Tool Co., Cincinnati.
Bardons & Oliver, Inc., Cleveland.
Gisholt Mch. Co., Madison, Wis.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland.

LATHES, CRANKSHAFT

Consolidated Mch. Tool Corp., Rochester, N. Y.
Le Blond, R. K., Mch. Tool Co., Cincinnati.
Sundstrand Mch. Tool Co., Rockford, Ill.

LATHES, DOUBLE-END

Consolidated Mch. Tool Corp., Rochester, N. Y.
Sundstrand Mch. Tool Co., Rockford, Ill.

LATHES, ENGINE AND TOOLROOM

Acme Machine Tool Co., Cincinnati.
Axelson Manufacturing Co., Los Angeles, Calif.
American Tool Wks. Co., Cincinnati.
Cincinnati Lathe & Tool Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Gerard Machine Co., Inc., 60 Park Place, Newark, N. J.

Le Blond, R. K., Mch. Tool Co., Cincinnati.

Lodge & Shipley Mch. Co., Cincinnati.
Monarch Mch. Tool Co., Sidney, O.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.

Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.

Rockford Mch. Tool Co., Rockford, Ill.

Seneca Falls Mch. Co., Seneca Falls, N. Y.
South Bend Lathe Wks., Inc., South Bend, Ind.

Springfield Mch. Tool Co., Springfield, O.

LATHES, EXTENSION BED AND GAP

Cincinnati Lathe & Tool Co., Oakley, Cincinnati.
Gisholt Mch. Co., Madison, Wis.
Le Blond, R. K., Mch. Tool Co., Cincinnati.
Lodge & Shipley Mch. Tool Co., Cincinnati.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
South Bend Lathe Wks., Inc., South Bend, Ind.
Warner & Swasey Co., Cleveland.

LATHES, GUN

Consolidated Mch. Tool Corp., Rochester, N. Y.
Le Blond, R. K., Mch. Tool Co., Cincinnati.
Lodge & Shipley Mch. Tool Co., Cincinnati.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Springfield Mch. Tool Co., Springfield, O.

LATHES, MANUFACTURING TYPE

Lodge & Shipley Mch. Tool Co., Cincinnati.

LATHES, SPINNING

See Chucking Machines.

LATHES, TOOLROOM

See Lathes, Engine and Toolroom.

LATHES, TURRET

Acme Machine Tool Co., Cincinnati.
Bardons & Oliver, Inc., Cleveland.
Cincinnati Lathe & Tool Co., Oakley, Cincinnati.
Foster Mch. Co., Elkhart, Ind.
Gisholt Mch. Co., Madison, Wis.
Hardinge Brothers, Inc., Elmira, N. Y. (Bench or Cabinet Mounting)
International Mch. Tool Co., Inc., Indianapolis, Ind.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond, R. K., Mch. Tool Co., Cincinnati.
National Acme Co., Cleveland.
Morey Machinery Co., Inc., 410 Broome St., New York, N. Y.
Potter & Johnston Mch. Co., Pawtucket, R. I.
Rivett Lathes & Grinder, Inc., Brighton, Boston, Mass.
South Bend Lathe Wks., Inc., South Bend, Ind.
Springfield Mch. Tool Co., Springfield, O.
Stark Tool Co., Waltham, Mass.
Warner & Swasey Co., Cleveland.

LATHES, TURRET AUTOMATIC

Potter & Johnston Mch. Co., Pawtucket, R. I.

LAYOUT FLUID

Dayton Rogers Mfg. Co., Minneapolis, Minn.

LEVELS

Pratt & Whitney Co., Hartford, Conn.
Starrett, L. S., Co., Athol, Mass.
Universal Boring Mch. Co., Hudson, Mass.

LUBRICANTS, INCLUDING EXTREME PRES-SURE (E. P.) MACHINERY LUBRICANTS

Lubri-Zol Corp., Cleveland, O.
Standard Oil Co. (Indiana), 910 S. Michigan Ave., Chicago.

Stuart, D. A., Oil Co., Ltd., 2727 S. Troy St., Chicago.

Sun Oil Co., Philadelphia.
Texas Co., 135 E. 42nd St., New York.

LUBRICATING SYSTEMS

Farval Corp., Cleveland.
Madison-Kipp Corp., Madison, Wis.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.

MACHINISTS' SMALL TOOLS

See Calipers, Hammers, Wrenches, Drills, Taps, etc.

MAGNESIUM

Dow Chemical Co., Midland, Mich.

MANDRELS

See Arbors and Mandrels.

MEASURING MACHINES, PRECISION

Federal Products Corp., Providence, R. I.
Hanson-Whitney Mch. Co., Hartford, Conn.
Norma-Hoffmann Bearings Corp., Stamford, Conn.
Pratt & Whitney Co., Hartford, Conn.

METALS, BEARING

See Bearings, Bronze, Babbitt, etc., and Bushings, Brass, Bronze, etc.

METALS PERFORATED

Chicago Perforating Co., 2445 W. 24th Place, Chicago.

METERS (See Recording Instruments)

MICROMETERS

Bath, John, & Co., Inc., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence.
Pratt & Whitney Co., Hartford, Conn.
Starrett, L. S., Co., Athol, Mass.

MILLING ATTACHMENTS

Brown & Sharpe Mfg. Co., Providence.
Cincinnati Milling Machine Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Elgin Tool Wks., Inc., Berteau & Ravenswood Ave., Chicago.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Reed-Prentice Corp., Worcester, Mass.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Sundstrand Machine Tool Co., Rockford, Ill.
Van Norman Mch. Tool Co., Springfield, Mass.

MILLING MACHINES, AUTOMATIC

Cincinnati Milling Machine Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Ingersoll Milling Mch. Co., Rockford, Ill.
Jones & Lamson Mch. Co., Springfield, Vt.
Kearney & Trecker Corp., Milwaukee, Wis.
Potter & Johnston Mch. Co., Pawtucket, R. I.
Sundstrand Machine Tool Co., Rockford, Ill.
U. S. Tool Company, Inc., Amper, N. J.

MILLING MACHINES, BENCH

Ames, B. C., Co., Waltham, Mass.
Hardinge Brothers, Inc., Elmira, N. Y.
(Bench or Pedestal Type)
Pratt & Whitney Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.
Sundstrand Machine Tool Co., Rockford, Ill.

MILLING MACHINES, CIRCULAR CONTINUOUS

Consolidated Machine Tool Corp., Rochester, N. Y.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Sundstrand Machine Tool Co., Rockford, Ill.

MILLING MACHINES, DIE SINKING

See Die Sinking Machines.

MILLING MACHINES, DUPLEX

Cincinnati Milling Mch. Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.

MILLING MACHINES, HAND

Frew Machine Co., Philadelphia.
Sundstrand Machine Tool Co., Rockford, Ill.
Van Norman Mch. Tool Co., Springfield, Mass.

MILLING MACHINES, HORIZONTAL, PLAIN AND UNIVERSAL

Brown & Sharpe Mfg. Co., Providence.
Cincinnati Milling Mch. Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Continental Machines, Inc., Minneapolis, Minn.
Frew Machine Co., Philadelphia.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Sundstrand Machine Tool Co., Rockford, Ill.
Van Norman Mch. Tool Co., Springfield, Mass.

MILLING MACHINES, LINCOLN TYPE

Brown & Sharpe Mfg. Co., Providence.
Sundstrand Machine Tool Co., Rockford, Ill.

MILLING MACHINES, PLANNER TYPE

Cincinnati Planer Co., Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Sellers, Wm., & Co., Inc., Philadelphia.
Stokerunit Corp., Milwaukee, Wis.

MILLING MACHINES, UNIVERSAL

Brown & Sharpe Mfg. Co., Providence.
Continental Machines, Inc., Minneapolis, Minn.
Gorton Machine Co., Racine, Wis.
Kearney & Trecker Corp., Milwaukee, Wis.

MILLING MACHINES, VERTICAL

Brown & Sharpe Mfg. Co., Providence.
Cincinnati Milling Mch. Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Continental Machines, Inc., Minneapolis, Minn.
Gorton Machine Co., Racine, Wis.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.
Sundstrand Machine Tool Co., Rockford, Ill.

MODEL AND EXPERIMENTAL WORK

See Special Machinery and Tools.

MOLD AND DIE COPYING MACHINES

Gorton Machine Co., Racine, Wis.

MOLDING MACHINES, PLASTIC PRODUCTS

Hydraulic Press Mfg. Co., Mt. Gilead, O.
Reed-Prentice Corp., Worcester, Mass.
Watson-Stillman Co., Roselle, N. J.

MOLYBDENUM

Climax Molybdenum, 500 Fifth Ave., New York.

MOTORS, ELECTRIC

Baldor Electric Co., St. Louis, Mo.
Dunmore Co., Racine, Wis.
General Electric Co., Schenectady, N. Y.
Van Dorn Electric Tools, Towson, Md.
Wagner Electric Co., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., E. Pittsburgh.

NIBBLING MACHINES

Gray Machine Co., Philadelphia.
Schatz Mfg. Co., Poughkeepsie, N. Y.

NICKEL

International Nickel Co., 67 Wall St., New York.

NIPPLE THREADING MACHINERY

Landis Mch. Co., Inc., Waynesboro, Pa.
Murchey Mch. & Tool Co., Detroit.

NUT SETTING EQUIPMENT

See Screw Driving and Nut Setting Equipment.

NUT TAPPERS

See Bolt and Nut Machinery.

NUTS, COLD FORGED, WING AND CAP

Parker-Kalon Corp., 200 Varick St., New York.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

OIL CUPS

Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.
Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago.
Trico Fuse Mfg. Co., Milwaukee, Wis.

OIL GROOVERS

Hanson-Whitney Mch. Co., Hartford, Conn.

OIL HOLE COVERS

Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago.

OILERS AND LUBRICATORS

Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago.
Madison-Kipp Corp., Madison, Wis.
Trico Fuse Mfg. Co., Milwaukee, Wis.

OILS, CUTTING

Sun Oil Co., Philadelphia.
Texas Co., 135 E. 42nd St., New York.

OILS, LUBRICATING

Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.
Standard Oil Co. (Indiana), 910 S. Michigan Ave., Chicago.
Stuart, D. A., Oil Co., Ltd., 2727 S. Troy St., Chicago.
Sun Oil Co., Philadelphia.
Texas Co., 135 E. 42nd St., New York.

OILS, QUENCHING AND TEMPERING

Shell Oil Co., Inc., New York, St. Louis, San Francisco.
Standard Oil Co. (Indiana), 910 S. Michigan Ave., Chicago.
Stuart, D. A., Oil Co., Ltd., 2727 S. Troy St., Chicago.

OILS, SOLUBLE—See Compounds, Cutting, Grinding, Metal Drawing, etc.

PACKING, LEATHER, METAL, RUBBER, ASBESTOS, ETC.

Garlock Packing Co., Palmyra, N. Y.
Greene, Tweed & Co., 101 Park Ave., New York, N. Y.
Manhattan Rubber Mfg. Div. Baybestos-Manhattan, Inc., Passaic, N. J.
Watson-Stillman Co., Roselle, N. J.

PARALLELS

Brown & Sharpe Mfg. Co., Providence.
Johansson Div. Ford Motor Co., Dearborn, Mich.
Starrett, L. S., Co., Athol, Mass.
Walker, O. S., Co., Inc., Worcester, Mass.

PATTERNS, WOOD

Mummert-Dixon Co., Hanover, Pa.

PHOSPHOR BRONZE—See Bronze

PILLOW BLOCKS

Jones, W. A., Fry, & Mch. Co., 4409 W. Roosevelt Road, Chicago.

Norma-Hoffmann Bearings Corp., Stamford, Conn.
Shafer Bearing Corp., 35 E. Wacker Drive, Chicago.

S. K. F. Industries, Inc., Philadelphia.
Standard Pressed Steel Co., Jenkintown, Pa.

PIPE CUTTING AND THREADING MACHINES

Foot-Burt Co., Cleveland.
Landis Mch. Co., Inc., Waynesboro, Pa.
Merrell Mfg. Co., Toledo, Ohio.
Murchey Mch. & Tool Co., Detroit.

PIPE, STEEL

Bethlehem Steel Co., Bethlehem, Pa.
National Tube Co. (U. S. Steel Corp. Div.), Pittsburgh.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

PIPE TONGS

Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

PLANNER ATTACHMENTS

Cincinnati Planer Co., Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Hanson-Whitney Mch. Co., Hartford, Conn.

PLANERS

Baldwin-Southwark Corp., Philadelphia, Pa.
Cincinnati Planer Co., Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
(Incl. Plate, Rotary & Crank Types)
Rockford Mch. Tool Co., Rockford, Ill.
Sellers, Wm., & Co., Inc., Philadelphia.

PLANERS, OPEN-SIDE

Cincinnati Planer Co., Cincinnati.

PLASTICS AND PLASTIC PRODUCTS

Bakelite Corp., 30 East 42nd St., New York.

PLATE ROLLS

Baldwin-Southwark Corp., Philadelphia, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Cleveland Punch & Shear Works Co., Cleveland, O.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Schatz Mfg. Co., Poughkeepsie, N. Y.

PLATES, SURFACE

Brown & Sharpe Mfg. Co., Providence.
U. S. Tool Company, Inc., Amper, N. J.

PNEUMATIC EQUIPMENT

Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Ingersoll-Rand Co., 11 Broadway, New York.

POLISHING LATHES AND MACHINES

Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.

Continental Machines, Inc., Minneapolis, Minn.
Gardner Machine Co., Beloit, Wis.
Production Mch. Co., Greenfield, Mass.
Sundstrand Mch. Tool Co., Rockford, Ill.
United States Electrical Tool Co., Cincinnati.

POLISHING TOOLS, PORTABLE

Stow Mfg. Co., Binghamton, N. Y.
Strand, N. A., & Co., 6001 N. Wolcott Ave., Chicago.

PORTABLE ELECTRIC DRILLS, REAMERS, TAPPERS, ETC.

Black & Decker Mfg. Co., Towson, Md.
Van Dorn Electric Tools, Towson, Md.

PRESSES, ARBOR

Baldwin-Southwark Corp., Philadelphia, Pa.
French Oil Mill Mchry. Co., Piqua, O.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Watson-Stillman Co., Roselle, N. J.

PRESSES, BROACHING

American Broach & Mch. Co., Ann Arbor, Mich.
V & O Press Co., Hudson, N. Y.
Watson-Stillman Co., Roselle, N. J.

PRESSES, EXTRUSION

Baldwin-Southwark Corp., Philadelphia, Pa.
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Lake Erie Engineering Corp., Buffalo, N. Y.
Watson-Stillman Co., Roselle, N. J.

PRESSES, FOOT

Baird Machine Co., Bridgeport, Conn.
Etna Machine Co., Toledo, O.
Niagara Machine & Tool Wks., Buffalo, N. Y.
V & O Press Co., Hudson, N. Y.

PRESSES, FORGING

Baldwin-Southwark Corp., Philadelphia, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Clearing Mch. Co., 6499 W. 65th St., Chicago.
Cleveland Punch & Shear Works Co., Cleveland, O.
French Oil Mill Mchry. Co., Piqua, O.
Henry & Wright Mfg. Co., Hartford, Ct.
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Lake Erie Engineering Corp., Buffalo, N. Y.
Morgan Engineering Co., Alliance, O.
Niagara Machine & Tool Wks., Buffalo, N. Y.
Schatz Mfg. Co., Poughkeepsie, N. Y.
V & O Press Co., Hudson, N. Y.
Watson-Stillman Co., Roselle, N. J.
Zeh & Hahemann Co., Newark, N. J.

PRESSES, HYDRAULIC

American Broach & Mch. Co., Ann Arbor, Mich.
Baldwin-Southwark Corp., Philadelphia, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Clearing Mch. Co., 6499 W. 65th St., Chicago.
Farrel-Birmingham Co., Inc., Buffalo, N. Y., & Ansonia, Conn.
French Oil Mill Mchry. Co., Piqua, O.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Lake Erie Engineering Corp., Buffalo, N. Y.
Morgan Engineering Co., Alliance, O.
National-Erie Corp., Erie, Pa.
Watson-Stillman Co., Roselle, N. J.

PRESSES, PERCUSSION

Zeh & Hahnemann Co., Newark, N. J.

PRESSES, SCREW

Niagara Machine & Tool Wks., Buffalo, N. Y.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Zeh & Hahnemann Co., Newark, N. J.

PRESSES, SHEET METAL WORKING

Baldwin-Southwark Corp., Philadelphia, Pa.
Bath, Cyril & Co., Cleveland, O.
Cincinnati Shaper Co., Cincinnati.
Clearing Machine Corp., 6499 W. 65th St., Chicago.
Cleveland Punch & Shear Works Co., Cleveland, O.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Federal Press Co., Elkhart, Ind.
General Machinery Corp. (Hooven-Owens-Rentschler Div.), Detroit, Mich.
Henry & Wright Mfg. Co., Hartford, Ct.
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Johnson Mch. & Press Corp., Elkhart, Ind.
Lake Erie Engineering Corp., Buffalo, N. Y.
Niagara Machine & Tool Wks., Buffalo, N. Y.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Steelweld Mchry. Div. of Cleveland Crane & Engrs. Co., Cleveland.
V & O Press Co., Hudson, N. Y.
Watson-Stillman Co., Roselle, N. J.
Zeh & Hahnemann Co., Newark, N. J.

PRESSES, STRAIGHTENING

Baldwin-Southwark Corp., Philadelphia, Pa.
Consolidated Mch. Tool Corp., Rochester, N. Y.
French Oil Mill Mchry. Co., Piqua, O.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Morgan Engineering Co., Alliance, O.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Springfield Mch. Tool Co., Springfield, O.
Watson-Stillman Co., Roselle, N. J.

PROFILING MACHINES

Consolidated Mch. Tool Corp., Rochester, N. Y.
Frew Machine Co., Philadelphia.
Gorton Machine Co., Racine, Wis.
Leland-Gifford Co., Worcester, Mass.
Morey Machinery Co., Inc., 410 Broome St., New York, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.

PULLEYS

Boston Gear Works, Inc., No. Quincy, Mass.
Continental Machines, Inc., Minneapolis, Minn.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
Sellers, Wm., & Co., Inc., Philadelphia.

PULLEYS, FRICTION CLUTCH

Brown & Sharpe Mfg. Co., Providence.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.

PUMPS, COOLANT, LUBRICANT AND OIL

Brown & Sharpe Mfg. Co., Providence.
Ingersoll-Rand Co., 11 Broadway, New York.
Ruthman Machinery Co., Cincinnati.
Viking Pump Co., Cedar Falls, Iowa.

PUMPS, HYDRAULIC

Baldwin-Southwark Corp., Philadelphia, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Brown & Sharpe Mfg. Co., Providence.
French Oil Mill Mchry. Co., Piqua, O.
Ingersoll-Rand Co., 11 Broadway, New York.
Racine Tool & Mch. Co., Racine, Wis.
Sundstrand Mch. Tool Co., Rockford, Ill.
Viking Pump Co., Cedar Falls, Iowa.
Watson-Stillman Co., Roselle, N. J.

PUMPS, PNEUMATIC

Ingersoll-Rand Co., 11 Broadway, New York.

PUMPS, ROTARY

Viking Pump Co., Cedar Falls, Iowa.

PUNCHES AND DIES

See Dies, Sheet Metal, etc.

PUNCHES, CENTERING

Cleveland Punch & Shear Works Co., Cleveland, O.

PUNCHING MACHINERY

Bath, Cyril & Co., Cleveland, O.
Cincinnati Shaper Co., Cincinnati.
Cleveland Punch & Shear Works Co., Cleveland, O.
Consolidated Machine Tool Corp., Rochester, N. Y.
Engineering & Research Corp., Riverdale, Md.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Niagara Machine & Tool Wks., Buffalo, N. Y.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Steelweld Mchry. Div. of Cleveland Crane & Engrs. Co., Cleveland.
Watson-Stillman Co., Roselle, N. J.
Wiedemann Machine Co., Philadelphia.

PUNCHING AND RIVETING MACHINES

Engineering & Research Corp., Riverdale, Md.
Hannifin Mfg. Co., Chicago.

PYROMETERS

Bristol Company, Waterbury, Ct.
Leeds & Northrup Co., Philadelphia.
Shore Instrument & Mfg. Co., Jamaica, N. Y.

RACKS, GEAR, CUT

Atlantic Gear Works, Inc., 124 Lafayette St., New York.
Boston Gear Works, Inc., No. Quincy, Mass.
Brown & Sharpe Mfg. Co., Providence.
Fellows Gear Shaper Co., Springfield, Vt.
Hartford Special Mchry. Co., Hartford, Conn.
Massachusetts Gear & Tool Co., Woburn, Mass.
Meisel Press Mfg. Co., Boston, Mass.

Philadelphia Gear Works, Philadelphia.
Stahl Gear & Machine Co., Cleveland.

REAMER HOLDERS

Gairing Tool Co., Detroit.
Gisholt Machine Co., Madison, Wis.
Landis Mch. Co., Inc., Waynesboro, Pa.
McCrosky Tool Corp., Meadville, Pa.
Warner & Swasey Co., Cleveland.

REAMERS

Barber-Colman Co., Rockford, Ill.
Butterfield Div. Union Twist Drill Co., Derby Line, Vt.
Carboloy Co., Inc., Detroit.
Cleveland Twist Drill Co., Cleveland.
Columbus Die, Tool & Mch. Co., Columbus, O.
Davis Boring Tool Div., St. Louis, Mo.
Ex-Cell-O Corporation, Detroit.
Firth-Sterling Steel Co., McKeesport, Pa.
Gairing Tool Co., Detroit.
Gammons-Holman Co., Manchester, Conn.
Gisholt Machine Co., Madison, Wis.
Greenfield Tap & Die Corp., Greenfield, Mass.
Haynes Stellite Co., Kokomo, Ind.

Illinois Tool Wks., 2501 N. Keeler Ave., Chicago.
McCrosky Tool Corp., Meadville, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.

REAMERS, ADJUSTABLE

Barber-Colman Co., Rockford, Ill.
Carboloy Co., Inc., Detroit.
Cleveland Twist Drill Co., Cleveland.
Davis Boring Tool Div., St. Louis, Mo.
Ex-Cell-O Corporation, Detroit.
Gairing Tool Co., Detroit.
Gisholt Machine Co., Madison, Wis.
Greenfield Tap & Die Corp., Greenfield, Mass.
Madison Mfg. Co., Muskegon, Mich.
McCrosky Tool Corp., Meadville, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.

REAMERS, TAPER PIN

Butterfield Div. Union Twist Drill Co., Derby Line, Vt.

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Union Twist Drill Co., Athol, Mass.

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Van Norman Mch. Tool Co., Springfield, Mass.

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Leeds & Northrup Co., Philadelphia.

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Bristol Company, Waterbury, Ct.
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Bristol Company, Waterbury, Ct.
Leeds & Northrup Co., Philadelphia.

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Bristol Company, Waterbury, Ct.
Leeds & Northrup Co., Philadelphia.

RECORDING INSTRUMENTS FOR TIME

Bristol Company, Waterbury, Ct.

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S. & S. Mch. Wks., 4541 W. Lake St., Chicago.
U. S. Tool Company, Inc., Ampere, N. J.

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Leeds & Northrup Co., Philadelphia.

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American Swiss File & Tool Co., Elizabeth, N. J.
Bethlehem Steel Co., Bethlehem, Pa.
Cleveland Punch & Shear Works Co., Cleveland, O.

RIVETERS, HYDRAULIC

Baldwin-Southwark Corp., Philadelphia, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Hydraulic Press Mfg. Co., Mount Gilead, O.
Morgan Engineering Co., Alliance, O.

RIVETERS, PNEUMATIC

Grant Mfg. & Mch. Co., Bridgeport, Conn.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Ingersoll-Rand Co., 11 Broadway, New York.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

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Engineering & Research Corp., Riverdale, Md.
Grant Mfg. & Mch. Co., Bridgeport, Conn.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.

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Onsrud Machine Works, Inc., 3940 Palmer St., Chicago, Ill.

RUBBER PRODUCTS

Manhattan Rubber Mfg. Div. Raybestos-Manhattan, Inc., Passaic, N. J.

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Brown & Sharpe Mfg. Co., Providence.
Starrett, L. S., Co., Athol, Mass.

RUST PREVENTIVE

Oakite Products, Inc., 26 Thames St., New York.

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See Blast Cleaning Equipment.

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Carborundum Co., Niagara Falls, N. Y.
Delta Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York.
Stow Mfg. Co., Binghamton, N. Y.
Sundstrand Mch. Tool Co., Rockford, Ill.
United States Electrical Tool Co., Cincinnati.
Van Dorn Electric Tools, Towson, Md.
Walls Sales Corp., 96 Warren St., New York.

SAW BLADES, HACK

Armstrong-Blum Mfg. Co., 5743 Bloomingdale Ave., Chicago.

Starrett, L. S., Co., Athol, Mass.

SAW SHARPENING MACHINES

Earle Gear & Mch. Co., Philadelphia.
Huther Bros. Saw Mfg. Co., Inc., Rochester, N. Y.

SAWING MACHINES, CIRCULAR

Consolidated Mch. Tool Corp., Rochester, N. Y.
Earle Gear & Mch. Co., Philadelphia.
Etna Machine Co., Toledo, O.

SAWING MACHINES, FRICTION

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

SAWING MACHINES, METAL CUTTING BAND

Armstrong-Blum Mfg. Co., 5743 Bloomingdale Ave., Chicago.

Continental Machines, Inc., Minneapolis, Minn.
Delta Mfg. Co., Milwaukee, Wis.
Grob Bros. West Allis, Wis.
Huther Bros. Saw Mfg. Co., Inc., Rochester, N. Y.
Racine Tool & Mch. Co., Racine, Wis.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

SAWING MACHINES, POWER HACK

Armstrong-Blum Mfg. Co., 5743 Bloomingdale Ave., Chicago.

Racine Tool & Mch. Co., Racine, Wis.

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

SAWING MACHINES, WOOD

Delta Mfg. Co., Milwaukee, Wis.

SAWS, CIRCULAR METAL CUTTING

Consolidated Mch. Tool Corp., Rochester, N. Y.
Huther Bros. Saw Mfg. Co., Inc., Rochester, N. Y.
Illinois Tool Wks., 2501 No. Keeler Ave., Chicago.
National Twist Drill & Tool Co., Detroit.
Union Twist Drill Co., Athol, Mass.

SAWS, HOLE

Armstrong-Blum Mfg. Co., 5743 Bloomingdale Ave., Chicago.

SAWS, METAL CUTTING BAND

Armstrong-Blum Mfg. Co., 5743 Bloomingdale Ave., Chicago.

Delta Mfg. Co., Milwaukee, Wis.

Huther Bros. Saw Mfg. Co., Inc., Rochester, N. Y.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

SAWS, PORTABLE ELECTRIC

Black & Decker Mfg. Co., Towson, Md.
Van Dorn Electric Tools, Towson, Md.

SAWS, SCREW SLOTTING

Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Starrett, L. S., Co., Athol, Mass.
Union Twist Drill Co., Athol, Mass.

SCREW CUTTING TOOLS—See Taps and Dies.

SCREW DRIVING AND NUT SETTING EQUIPMENT

Black & Decker Mfg. Co., Towson, Md.
Errington Mechanical Laboratory, 200 Broadway, New York.

Haskins, R. G., Co., 617 S. California Ave., Chicago.

Ingersoll-Rand Co., 11 Broadway, New York.

Procurier Safety Chuck Co., 20 S. Clinton St., Chicago.

Stow Mfg. Co., Binghamton, N. Y.

Strand, N. A., & Co., 5001 N. Wolcott Ave., Chicago.

United States Electrical Tool Co., Cincinnati.

Van Dorn Electric Tools, Towson, Md.

SCREW MACHINES, AUTOMATIC SINGLE AND MULTIPLE SPINDLE

Brown & Sharpe Mfg. Co., Providence.
Cleveland Automatic Machine Co., Cleveland, O.
Cone Automatic Machine Co., Inc., Windsor, Vt.
Foot-Burt Co., Cleveland, O.
Greenlee Bros. & Co., Rockford, Ill.
National Acme Co., Cleveland.

SCREW MACHINES, HAND

See also Lathes, Turret.
Acme Machine Tool Co., Cincinnati.
Bardons & Oliver, Inc., Cleveland.
Brown & Sharpe Mfg. Co., Providence.
Foster Mch. Co., Elkhart, Ind.
Gisholt Mch. Co., Madison, Wis.
Hardinge Brothers, Inc., Elmira, N. Y.
Jones & Lamson Machine Co., Springfield, Vt.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Stark Tool Co., Waltham, Mass.
Warner & Swasey Co., Cleveland.

SCREW MACHINE TOOLS AND EQUIPMENT

Bardons & Oliver, Inc., Cleveland.
Brown & Sharpe Mfg. Co., Providence.
Cleveland Automatic Machine Co., Cleveland, O.
Foster Mch. Co., Elkhart, Ind.
Gisholt Mch. Co., Madison, Wis.
Greenlee Bros. & Co., Rockford, Ill.
Jones & Lamson Machine Co., Springfield, Vt.
Landis Mch. Co., Inc., Waynesboro, Pa.
Murphy Mch. & Tool Co., Detroit.
National Acme Co., Cleveland.
Potter & Johnston Machine Co., Pawtucket, R. I.
R & L Tools, Nicetown, Philadelphia.
Warner & Swasey Co., Cleveland.

SCREW MACHINE WORK

Eastern Mch. Screw Corp., New Haven, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Acme Co., Cleveland.
Standard Pressed Steel Co., Jenkintown, Pa.

SCREW PLATES

Bevy, Chas. H., & Co., 120-B N. Clinton St., Chicago.

Butterfield Div. Union Twist Drill Co., Derby Line, Vt.

Card, S. W., Mfg. Co., Mansfield, Mass.

Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

Pratt & Whitney Co., Hartford, Conn.

Winter Bros. Co., Wrentham, Mass.

SCREWS, CAP, SET, SAFETY SET AND MACHINE

Allen Mfg. Co., Hartford, Conn.
American Screw Co., Providence, R. I.
Continental Screw Co., New Bedford, Mass.
Corbin Screw Corp., New Britain, Conn.
Dardet Threadlock Corp., 55 Liberty St., New York.

Lamson & Sessions Co., Cleveland.
National Acme Co., Cleveland.
National Screw & Mfg. Co., Cleveland.
Parker-Kalon Corp., 200 Varick St., New York.
Pheoll Mfg. Co., 6700 W. Roosevelt Rd., Chicago.
Russell, Burdall & Ward Bolt & Nut Co., Port Chester, N. Y.

Scovill Mfg. Co., Waterbury, Conn.

Shakeproof Lock Washer Co., 2553 N. Keeler Ave., Chicago.

Standard Pressed Steel Co., Jenkintown, Pa.

Strong, Carlisle & Hammond Co., Cleveland.

SCREWS, SELF-TAPPING DRIVE

Parker-Kalon Corp., 200 Varick St., New York.

Shakeproof Lock Washer Co., 2553 N. Keeler Ave., Chicago, Ill.

SCREWS, THUMB

American Screw Co., Providence, R. I.
Parker-Kalon Corp., 200 Varick St., New York.
Williams, J. H., & Co., 225 Lafayette St., New York.

SEALS AND RETAINERS, OIL OR GREASE

Garlock Packing Co., Palmyra, N. Y.
Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago.

SEAMLESS STEEL TUBING

See Tubing, Seamless Steel.

SECOND-HAND MACHINERY, ETC.

Cincinnati Machinery & Supply Co., Cincinnati.
Eastern Machinery Co., Cincinnati.
Emerman, Louis E., & Co., 1701 Elston Ave., Chicago.

Miles Machinery Co., Saginaw, Mich.

Morey Mchry. Co., Inc., 410 Broome St., New York.

SEPARATORS, CENTRIFUGAL OIL

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American Steel & Wire Co., Cleveland.
Bethlehem Steel Co., Bethlehem, Pa.
Cumberland Steel Company, Cumberland, Md.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

Standard Pressed Steel Co., Jenkintown, Pa.

Union Drawn Steel Div., Massillon, O.

Union Twist Drill Co., Athol, Mass.

SHAFTING, STEEL TUBING FOR

La Salle Steel Co., P. O. Box 6800A, Chicago.

National Tube Co. (U. S. Steel Co. Div.), Pittsburgh.

SHAFTS, FLEXIBLE

Haskins, R. G., Co., 617 S. California Ave., Chicago.

Stow Mfg. Co., Inc., Binghamton, N. Y.

Strand, N. A., & Co., 5001 N. Wolcott Ave., Chicago.

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American Hollow Boring Co., Erie, Pa.

Bethlehem Steel Co., Bethlehem, Pa.

SHAFTS, TURNED AND GROUND

Bethlehem Steel Co., Bethlehem, Pa.
Cumberland Steel Company, Cumberland, Md.
La Salle Steel Co., P. O. Box 6800A, Chicago.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

Union Drawn Steel Div., Massillon, O.

SHAPERS

American Tool Wks., Co., Cincinnati.
Cincinnati Shaper Co., Cincinnati.
Onsrud Machine Works, Inc., 3940 Palmer St., Chicago, Ill.

Rockford Mch. Tool Co., Rockford, Ill.

Smith & Mills Co., Cincinnati.

SHAPERS, VERTICAL

Hanson-Whitney Mfg. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.

SHAPES, STRUCTURAL

Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp. (U. S. Steel Corp. Div.), Pittsburgh.

Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.

Tennessee Coal, Iron & R. R. Co. (U. S. Steel Corp. Div.), Birmingham, Ala.

SHEARING MACHINERY

Bethlehem Steel Co., Bethlehem, Pa.
Cleveland Punch & Shear Works Co., Cleveland, O.
Cincinnati Shaper Co., Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.

Morgan Engineering Co., Alliance, O.

Niagara Mch. & Tool Wks., Buffalo.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

Schatz Mfg. Co., Poughkeepsie, N. Y.

Watson-Stillman Co., Roselle, N. J.

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Cleveland Punch & Shear Works Co., Cleveland, O.

Consolidated Mch. Tool Corp., Rochester, N. Y.

Niagara Mch. & Tool Wks., Buffalo.

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

Schatz Mfg. Co., Poughkeepsie, N. Y.

Union Twist Drill Co., Athol, Mass.

SHEARS, SQUARING

Cincinnati Shaper Co., Cincinnati.
Cleveland Punch & Shear Works Co., Cleveland, O.

Consolidated Mch. Tool Corp., Rochester, N. Y.

Niagara Mch. & Tool Wks., Buffalo.

Schatz Mfg. Co., Poughkeepsie, N. Y.

SHEAVE WHEELS

Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.

SHEET METAL MACHINES, SHRINKING AND FORMING

Engineering & Research Corp., Riverdale, Md.

SHEET METALS

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Carnegie-Illinois Steel Corp. (U. S. Steel Corp. Div.), Pittsburgh.
Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.
Ingersoll Steel & Disc Div. Borg-Warner Corp., New Castle, Ind.
New Jersey Zinc Co., 160 Front St., New York.
Ryerson, Joseph T. & Son, Inc., 2558 W. 16th St., Chicago.
Tennessee Coal, Iron & R. R. Co. (U. S. Steel Corp. Div.), Birmingham, Ala.

SHEETS, IRON AND STEEL

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp. (U. S. Steel Corp. Div.), Pittsburgh.
Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.
Ryerson, Joseph T. & Son, Inc., 2558 W. 16th St., Chicago.
Tennessee Coal, Iron & R. R. Co. (U. S. Steel Corp. Div.), Birmingham, Ala.

SHEETS, PERFORATED

Chicago Perforating Co., 2445 W. 24th Place, Chicago.

SINE BARS

Johansson Div. Ford Motor Co., Dearborn, Mich.
Starrett, L. S. Co., Athol, Mass.

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Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.

SLOTTING MACHINES

Consolidated Mch. Tool Corp., Rochester, N. Y.
Rockford Mch. Tool Co., Rockford, Ill.
Sellers, Wm., & Co., Inc., Philadelphia.

SOCKETS

Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

SPECIAL MACHINERY AND TOOLS

Baird Machine Co., Bridgeport, Conn.
Barnes, W. F., & John, Co., Rockford, Ill.
Barnes Drill Co., Rockford, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Bilgram Gear & Mch. Wks., Philadelphia.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.
Blanchard Machine Co., Cambridge, Mass.
Columbus Die, Tool & Machine Co., Columbus, O.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis Boring Tool Co., Inc., St. Louis, Mo.
Earle Gear & Mch. Co., Philadelphia.
Elgin Tool Wks., Inc., Bertraw & Ravenswood Ave., Chicago.
Ex-Cell-O Corp., Detroit.
Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.
Gairing Tool Co., Detroit.
Gisholt Mch. Co., Madison, Wis.
Gorton Machine Co., Racine, Wis.
Grant Mfg. & Mch. Co., Bridgeport, Conn.
Greenlee Bros. & Co., Rockford, Ill.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Hartford Special Mch. Co., Hartford, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, O.
Ingersoll Milling Mch. Co., Rockford, Ill.
Lake Erie Engineering Corp., Buffalo, N. Y.
Langelier Mfg. Co., Providence.
Modern Machine Corp., Brooklyn, N. Y.
Moline Tool Co., Moline, Ill.
Morgan Engineering Co., Alliance, O.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Acme Co., Cleveland.
National-Erie Corp., Erie, Pa.
National Twist Drill & Tool Co., Detroit.
New Jersey Gear & Mfg. Co., Newark, N. J.
Niagara Mch. & Tool Wks., Buffalo.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.
Ruthman Machinery Co., Cincinnati.
S. & S. Mch. Works, 4541 W. Lake St., Chicago.
Sundstrand Machine Tool Co., Rockford, Ill.
Union Twist Drill Co., Athol, Mass.
U. S. Tool Company, Inc., Ampere, N. J.
V & O Press Co., Hudson, N. Y.
Waltham Mch. Wks., Waltham, Mass.

SPEED REDUCERS

Atlantic Gear Works, Inc., 124 Lafayette St., New York.
Boston Gear Works, Inc., No. Quincy, Mass.
Cleveland Worm & Gear Co., Cleveland.
Cullman Wheel Co., Altgeld St., Chicago.
Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.
Ganschow Gear Co., 16 N. Morgan St., Chicago.
General Electric Co., Schenectady, N. Y.
Grant Gear Works, Inc., Boston, Mass.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
Morse Chain Co., Ithaca, N. Y.
Philadelphia Gear Works, Philadelphia.
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

SPEIGELEISEN

New Jersey Zinc Co., 160 Front St., New York.

SPINDLES, GRINDING

Ex-Cell-O Corporation, Detroit.

SPINDLES, HOLLOW BORED

American Hollow Boring Co., Erie, Pa.

SPINNING LATHES

See Chucking Machines.

SPRING COILING AND FORMING MACHINERY

Baird Machine Co., Bridgeport, Conn.

SPRINGS, WIRE

American Steel & Wire Co. (U. S. Steel Corp. Div.), Cleveland.
Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.
Lee Spring Co., Brooklyn, N. Y.

SPROCKET CHAINS

Atlantic Gear Works, Inc., 124 Lafayette St., New York.
Boston Gear Works, Inc., No. Quincy, Mass.
Cullman Wheel Co., 1339 Altgeld St., Chicago.
Grant Gear Works, Inc., Boston, Mass.
Morse Chain Co., Ithaca, N. Y.
Philadelphia Gear Works, Philadelphia.

SPROCKETS

Atlantic Gear Works, Inc., 124 Lafayette St., New York.
Boston Gear Works, Inc., No. Quincy, Mass.
Cullman Wheel Co., 1339 Altgeld St., Chicago.
Grant Gear Works, Inc., Boston, Mass.
Hartford Special Mch. Co., Hartford, Conn.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
Morse Chain Co., Ithaca, N. Y.
National-Erie Corp., Erie, Pa.
Philadelphia Gear Works, Philadelphia.
Whitney Chain & Mfg. Co., Hartford, Conn.

STAMPINGS, SHEET METAL

Dayton Rogers Mfg. Co., Minneapolis, Minn.
Shakeproof Lock Washer Co., 2553 N. Keeler Ave., Chicago, Ill.
Taylor-Shantz, Inc., Rochester, N. Y.

STAMPS, STEEL AND MARKING DIES

Pittsburgh Stamp Co., Inc., Pittsburgh.

STEEL

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
American Steel & Wire Co. (U. S. Steel Corp. Div.), Cleveland.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp. (U. S. Steel Corp. Div.), Pittsburgh.
Carpenter Steel Co., Reading, Pa.
Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Ingersoll Steel & Disc Div. Borg-Warner Corp., New Castle, Ind.
Jessop Steel Co., Washington, Pa.
National Tube Co. (U. S. Steel Corp. Div.), Pittsburgh.
Ryerson, Joseph T. & Son, Inc., 2558 W. 16th St., Chicago.
Tennessee Coal, Iron & R. R. Co. (U. S. Steel Corp. Div.), Birmingham, Ala.
Timken Roller Bearing Co., Canton, O.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

STEEL ALLOYS

See Alloy-steels.

STEEL BARS

See Bars, Steel.

STEEL, COLD DRAWN

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
American Steel & Wire Co. (U. S. Steel Corp. Div.), Cleveland.
Bethlehem Steel Co., Bethlehem, Pa.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
La Salle Steel Co., P. O. Box 6800A, Chicago.
National Tube Co. (U. S. Steel Corp. Div.), Pittsburgh.
Ryerson, Joseph T. & Son, Inc., 2558 W. 16th St., Chicago.
Timken Roller Bearing Co., Canton, O.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

STEEL, COMPOSITE TOOL AND DIE

Jessop Steel Co., Washington, Pa.

STEEL, HIGH SPEED TOOL

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Brothers Tool Co., 313 N. Francisco Ave., Chicago.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., Reading, Pa.
Cleveland Twist Drill Co., Cleveland.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Jessop Steel Co., Washington, Pa.
Ryerson, Joseph T. & Son, Inc., 2558 W. 16th St., Chicago.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

STEEL, MACHINE

Bethlehem Steel Co., Bethlehem, Pa.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Jessop Steel Co., Washington, Pa.
La Salle Steel Co., P. O. Box 6800A, Chicago.
Ryerson, Joseph T. & Son, Inc., 2558 W. 16th St., Chicago.
Timken Roller Bearing Co., Canton, O.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

STEEL, RUSTLESS

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., Reading, Pa.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Jessop Steel Co., Washington, Pa.

STEEL, STAINLESS

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
American Steel & Wire Co. (U. S. Steel Corp. Div.), Cleveland.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp. (U. S. Steel Corp. Div.), Pittsburgh.
Carpenter Steel Co., Reading, Pa.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Ingersoll Steel & Disc Div. Borg-Warner Corp., New Castle, Ind.
Jessop Steel Co., Washington, Pa.
National Tube Co. (U. S. Steel Corp. Div.), Pittsburgh.
Ryerson, Joseph T. & Son, Inc., 2558 W. 16th St., Chicago.
Timken Roller Bearing Co., Canton, O.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

STEEL STOCK GROUND FLAT

Brown & Sharpe Mfg. Co., Providence.
Starrett, L. S. Co., Athol, Mass.

STEEL, STRIP AND SHEET

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
American Steel & Wire Co. (U. S. Steel Corp. Div.), Cleveland.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp. (U. S. Steel Corp. Div.), Pittsburgh.
Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.
Jessop Steel Co., Washington, Pa.
Ryerson, Joseph T. & Son, Inc., 2558 W. 16th St., Chicago.
Tennessee Coal, Iron & R. R. Co. (U. S. Steel Corp. Div.), Birmingham, Ala.
Thomas Steel Co., Warren, O.

STEEL, ZINC, TIN AND COPPER COATED STRIP

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Thomas Steel Co., Warren, O.

STELLITE

Haynes Stellite Co., Kokomo, Ind.

STOCKS, DIE

Butterfield Div. Union Twist Drill Co., Derby Line, Vt.
Card, S. W., Mfg. Co., Mansfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.

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STOOLS

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Consolidated Mch. Tool Corp., Rochester, N. Y.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
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Modern Tool Wks., Rochester, N. Y.
Procurier Safety Chuck Co., 20 S. Clinton St., Chicago.

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Leeds & Northrup Co., Philadelphia.
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Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.

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Allen Mfg. Co., Hartford, Conn.

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Modern Tool Wks., Rochester, N. Y.
Procurer Safety Chuck Co., 20 S. Clinton St., Chicago.

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Barnes Drill Co., Rockford, Ill.
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Geometric Tool Co., New Haven, Conn.
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Hill Acme Co., Cleveland.
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Modern Tool Wks., Rochester, N. Y.
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Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Illinois Tool Wks., 2501 N. Keeler Ave., Chicago.
Jessop Steel Co., Washington, Pa.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

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Haynes Stellite Co., Kokomo, Ind.

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Lovejoy Tool Co., Inc., Springfield, Vt.
Rand L. Tools, Nicetown, Philadelphia.
Ready Tool Co., Bridgeport, Conn.
Warner & Swasey Co., Cleveland.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

TOOLMAKERS' INSTRUMENTS

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Starrett, L. S., Co., Athol, Mass.

TOOL STEEL

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., Reading, Pa.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Jessop Steel Co., Washington, Pa.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

TOOLS, CARBIDE-TIPPED

Carboly Co., Inc., Detroit.
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Firth-Sterling Steel Co., McKeesport, Pa.
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Morse Twist Drill & Mch. Co., New Bedford, Mass.
Vanadium Alloys Steel Co., Latrobe, Pa.

TOOLS, LATHE, SHAPER AND PLANNER

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Haynes Stellite Co., Kokomo, Ind.
Illinois Tool Wks., 2501 N. Keeler Ave., Chicago.
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Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Timken Roller Bearing Co., Canton, O.

TUBING, STEEL AND SEAMLESS STEEL

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Bisset Steel Co., Cleveland.
National Tube Co. (U. S. Steel Corp. Div.), Pittsburgh.

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

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Watson-Stillman Co., Roselle, N. J.

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VISES, MACHINE

Armstrong-Blum Mfg. Co., 5743 Bloomingdale Ave., Chicago.
Armstrong Brothers Tool Co., 313 N. Francisco Ave., Chicago.
Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence.
Desmond-Stephan Mfg. Co., Urbana, O.
Graham Mfg. Co., Providence.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
Purvis, Edw., & Son, Brooklyn, N. Y.

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Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

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American Steel & Wire Co. (U. S. Steel Corp. Div.), Cleveland.
Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.

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WRENCHES, PIPE

Greenfield Tap & Die Corp., Greenfield, Mass.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

WRENCHES, RATCHET

Greene, Tweed & Co., 101 Park Ave., New York.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

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Butterfield Div. Union Twist Drill Co., Derby Line, Vt.

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Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
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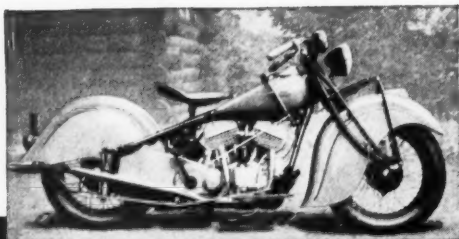
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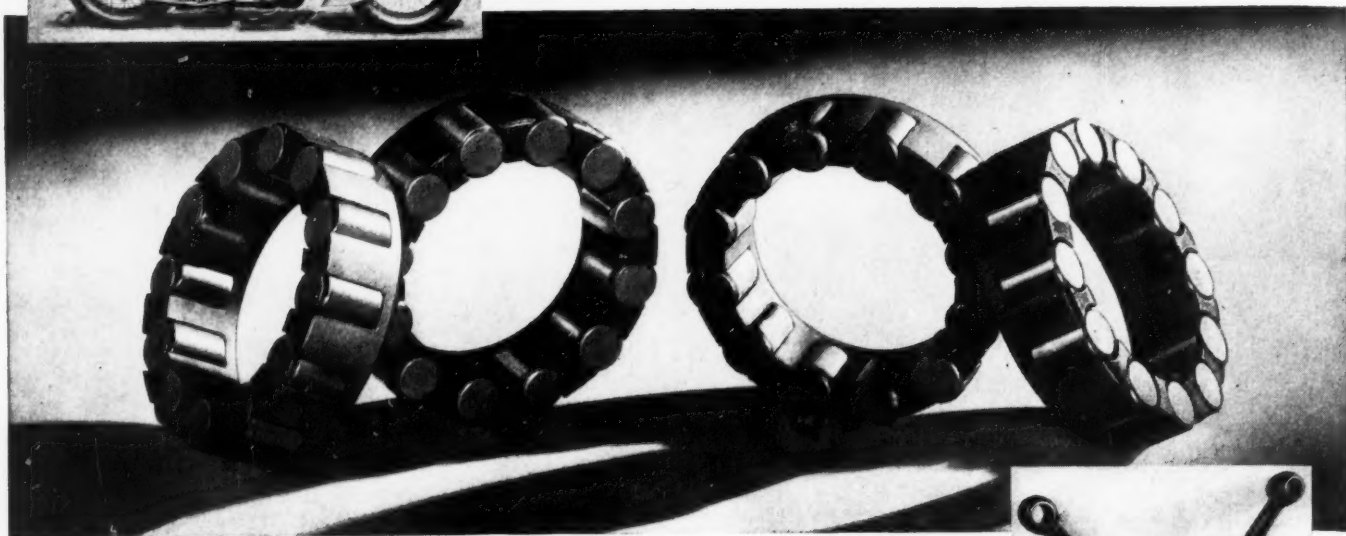
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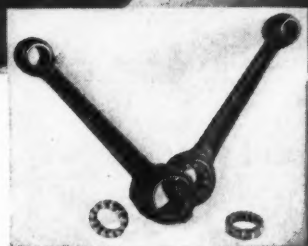
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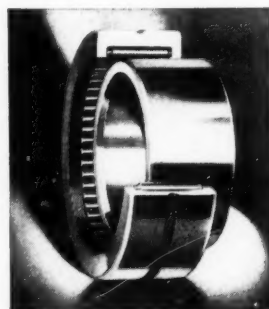
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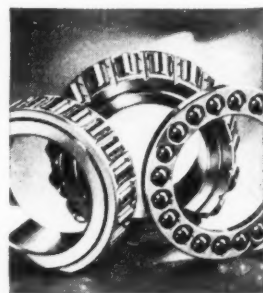
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